THE

YEAR-BOOK OF FACTS

IN

SCIENCE AND THE ARTS

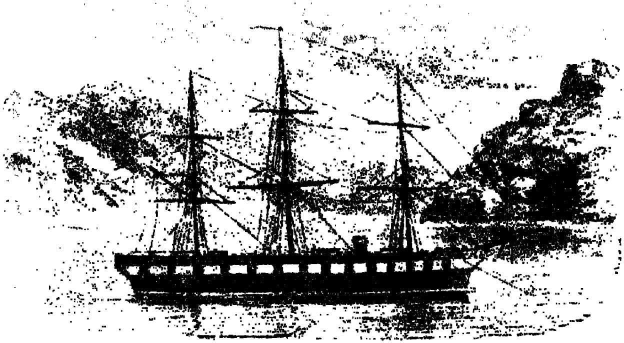
FOR

1876.

BY

JAMES MASON,

EDITOR OF "THE ANNUAL SUMMARY."



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PREFACE.

A NEW volume of a work which has so long enjoyed public favour stands little in need of a preface. But it may be as well to point out that several improvements have this year been introduced, all tending, we hope, to increase its popularity and usefulness.

The "Year Book of Facts," as hitherto, will form a complete annual record of scientific and material progress. The time covered by it, however, will begin with the 15th of October of each year and end with the 15th of October following. Hitherto it has begun and ended with the 31st of December.

The arrangement has been entirely remodelled, and the articles have been selected with a view to general rather than special interest. They will be found, we believe, to give a clear and entertaining view of the leading facts of a wonderful age.

The information contained in the following pages has been drawn from the most reliable sources, and pains have been taken to secure accuracy. To many friends we are indebted for information, and to these we tender our sincere thanks. A compilation of this sort may be greatly aided and improved by the information and suggestions of others, and we shall be glad at all times to receive communications relating to subjects of scientific research.

GRAY'S INN CHAMBERS, LONDON,
6th January, 1877.

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THE

YEAR-BOOK OF FACTS.

I.—THE HUMAN RACE.

Fair Hair and Blue Eyes in Germany.—For a long time the idea of a German, more particularly of a German lady, was that he or she had blue eyes and fair hair. The Germans themselves have frequently protested against this sweeping assertion, and a careful examination of a German regiment or a German school, would have sufficed to show the strong admixture of black hair and brown eyes. But anthropologists went on asserting their own views, formed on what they called their own long experience, till at last the public insisted on having the matter settled by a regular census. Government assented, and on a certain day every school in Prussia had to make a return of the black, and blue, and brown colour of the children's eyes. Many of the pupils came home on that day telling their parents, with a mysterious air, that their eyes, and hair, and skin, had been examined at school. Some of the parents thought it an undue interference with their rights, but the thing was done, and angry protests against what the government commands or allows to be done, are of little avail in Germany.

The results of this anthropological commission have been published, and they are, at all events, curious, though, perhaps, not of much scientific value. The number of persons examined in Prussia amounted to 4,127,766. Out of that number, 4,070,923 were under fourteen years of age. With regard to the colour of their eyes, 42·97 per cent. had blue, 24·31 per cent. brown eyes. With regard to the colour of the hair, 72 per cent. had blonde, 26 per cent. brown, and 1·21 per cent. black hair. With regard to the colour of the skin, Prussia has only 6·53 per cent. of brunette complexion. In Bavaria the brunette complexion claims 15 per cent., the black hair 5 per cent., the brown hair 41 per cent., the fair hair 54 per cent.; and it is argued from this that the darker complexion in Germany came from the south—rather a bold generalization, if one considers the mixture of tribes in Germany, even at so late a time as the invasion of the barbarians into the Roman empire. The Report contains a number of curious observations; for instance, that nearly one-third of the Jewish school-children are fair, which would certainly not be the impression left upon a casual spectator by the ordinary run of the Jewish population.—*Times.*

The Effect of the Seasons on the Body.—The curious fact has recently been pointed out by Dr. B. W. Richardson, that the changes of the seasons have a potent physical influence upon the body. Some years ago, in a convict establishment in England, a number of men were confined amid surroundings (of clothing, room, food, &c.) practically the same for each individual. The medical superintendent of the

gaol undertook investigations, extended over some nine years, and during which over 4000 individuals were weighed. It was found that during the months of winter, the body wastes, the loss of weight varying in increasing ratio; that during summer, the body gains, the gain varying in increasing ratio; and that the changes from gain to loss and from loss to gain are abrupt, and take place, the first at the beginning of September, and the second at the beginning of April. This is shown in the following figures, indicating the ratio of loss or gain:—Loss: January 0·14, February 0·24, March 0·95. Gain: April 0·03, May 0·01, June 0·52, July 0·08, August 0·70. Loss: September 0·21, October 0·10, November (exception) a slight gain, December 0·03.

Savage Life in the South Sea Islands.—Mr. Kerry Nichols read a paper before the British Association "On the New Hebrides, Banks, and Santa Cruz Islands." The natives inhabiting these islands seemed to owe their origin to the same stock from which the western and southern portions of New Guinea and the islands lying immediately to the southward of that country appear to have been peopled. The stock was evidently Papuan, and had, by its numerous and wide-spreading branches, not only extended itself over the islands of the coral sea, but as far east as the Fijis, in which latter country, however, the race had evidently received a great infusion of Malay blood. Whatever opinion might be formed on the identity of the present race, the striking resemblance in person, feature, language, and customs which prevailed throughout, justified the conclusion that the original population issued from the same source, and that the peculiarities and characteristics which distinguish the tribes or communities on different islands, had been mainly brought about by long separation, local circumstances, and the intercourse of foreign traders and settlers.

Physically considered, these people were a well-built, athletic race of savages, who appeared to inherit, in a very marked degree, all the characteristics of the Papuan race. The men average about 5 feet 6 inches in height, are erect in figure, with broad chests and massive limbs, which in many instances display great muscular development. The colour of the skin was usually of a dark reddish brown, but sometimes it was quite black, and was often covered with a short, curly hair, especially about the breast, back, and shoulders. Mr. Nichols saw several instances in the Island of Tanna, where the body was almost completely covered in this way. The natives had well-formed heads, the cranium in the majority of instances betokening a fair degree of mental development.

The hair, which formed one of the most remarkable features of this race, was distributed thickly over the head in the form of small spiral curls, and when allowed to grow in its natural way, had a woolly appearance, and resembled at first glance that of the African negro, but it was in reality much finer and softer. The beard was worn short, and usually trimmed, with a tuft beneath the chin. The men shave with the teeth of the shark, an oyster shell, or a piece of bottle glass, and perform the operation with the skill of accomplished barbers. In the northern islands they went completely naked; but in the southern islands, where the climate was slightly cooler, they affected a scant covering, after the fashion of the primitive fig-leaf. They were fond of decorating the head with flowers and feathers, and of tattooing the face with red and blue pigments, which imparted to

them a savage and ferocious look. All things considered, the physical condition of the islanders did not appear to manifest any sign of degeneration.

The slight idea of religion possessed by the islanders might be described as the most primitive form of paganism. On some of the islands they worshipped rude idols of wood, while in others they seemed to put implicit faith in imaginary gods who were supposed to inhabit the highest mountain tops. The dread of evil spirits and demons was universal among them. The natives of each island had a distinctive dialect of their own, and even the various tribes inhabiting each island had also distinct and separate dialects.

The Population of France. —The slow increase of population in France has attracted considerable attention lately, and is a matter of no little concern to some of her public men. The increase is hardly more than 100,000 inhabitants a-year. The most wealthy regions are those in which the population is most retarded; in the poorest parts the excess of births over deaths is greatest. Normandy is constantly going back; and in ten years Calvados has been reduced from 475,000 inhabitants to 452,000. In Brittany, on the other hand, the number of inhabitants increases every year.

Horned Men in Africa.—At a meeting of the British Association, Commander Cameron read part of a paper by Capt. J. S. Hay, relative to the strange malformation among people in the district of Akem, West Africa, the first announcement of which was received with some incredulity. The malformation in question is confined to the male sex, and consists in a protuberance or enlargement of the cheek bones under the eyes, taking the form of horns on each side of the nose. The malformation begins in childhood, but does not appear to be hereditary. It presents no resemblance to a diseased structure, nor is it a raised cicatrix. "On the contrary," says Captain Hay, "I have seen children with this peculiarity of structure whose parents were doing their utmost (though ineffectually) to stop it by medicines and applications."

A Brobdignagian Boy.—A correspondent of the "Journal of Horticulture" gives a few particulars of the Brobdignagian boy of Swanley, Kent, the most "wonderful specimen of humanity to be found in her Majesty's dominions" at home or abroad. "His name is Richard Beenham, he was twelve years of age on the 31st of August, his height is 5 feet, his girth round the waist is 69 inches, and his weight upwards of 24 stones of 14lb. to the stone. He is healthy and in possession of his faculties. His father is a basket-maker, and the 'boy' appears to be learning the business."

Two Prehistoric Spectacles. —A correspondent of the *Times* describes two thoroughly prehistoric spectacles which he witnessed in Fiji. One was a young girl dressed in two yards of calico print and a girdle of leaves, breaking "ivi" nuts—a kind of large coarse chestnut with a hard shell—with a genuine stone adze, fixed to its ooden handle by coils of plaite string. The other was a littl shrivelled old woman, wh making an earthenware vessel, nearly as large as herself, with no other implements than a round flattened pebble about four inches in diameter, and a piece of wood about as large as the back of an ordinary hair brush, slightly concave on the surface. Dipping both stone and wood frequently in water she moulded the inside of the huge pot with the former, and patted the outside into

shape simultaneously with the latter. The vessel was egg-shaped, the opening being at the top or large end of the egg. It was nearly three feet in height and two in diameter, and was formed of clay found near the village. When it is complete a fire is built round it on the ground, and it is carefully baked before being removed. In the houses these pots are placed on their side with the mouth inclined slightly upwards, and are seldom exposed to the risk of breakage by removal from their side. They are, of course, very fragile, but in the hands of the natives they are said to last for years.

The Ancestor of Man.—In reference to the question, from which of the quadrumana did man originate, Professor Haeckel, in his recent work, "The History of Creation," gives his opinion that the human race is a small branch of the group of *catarrhini*, and has developed out of long since extinct apes of this group in the old world. And, when on this subject, he refers to Professor Huxley's remarks, which show that man is, nearly as much as the ape, a four-handed animal; for various tribes of men, the Chinese boatmen, the Bengalee workmen, and the negroes when climbing, use the great toe in the same manner as the monkey, and, therefore, the possession of only a single pair of hands is not to be looked on as a characteristic of the human race. He also points out a fact, necessary to be observed by unscientific people — namely, that none of the manlike apes are to be regarded as the parents of the human race, but that the apelike progenitors of the human race are long since extinct. In concluding his work, Professor Haeckel remarks on the desire of some who are not actually opponents of the doctrine of descent. "They wait," he says, "the sudden discovery of a human race with tails, or of a talking species of apes." But such manifestations, the author observes, would not furnish the proof desired; and unthinking persons would be provided with as satisfactory (?) arguments as they nowadays employ in hurling their defiance against all who are evolutionists.

Natives of British Guiana.—Mr. William Harper contributed a paper to the September meeting of the British Association "On the Natives of British Guiana," who were generally said to belong to five tribes, namely, the Arawacks, the Caribs, the Accawoi, the Macuri, and the Warans. Representatives of several other tribes were, however, frequently met with on British soil. These people were merely remnants of a few barbarous tribes found, for the most part, between the Amazon and the Orinoco. It was extremely difficult to obtain any information as to the origin of these tribes; and the general result of the author's investigations was that, though it did not now admit of proof, it was very probable that all the Brasilio-Guarani tribes came from the north, though not at the same time. Of the tribes in British Guiana, the Warans and the Macuri had probably been longer in the country than the Caribs, Accawoi, and Arawacks. These tribes differed a good deal from one another in their language, characteristics, and habits, but not in their outward appearance or mode of living.

The author suggested that light might be thrown on the origin of these tribes by collecting fac-similes of the rock-writing to be found among them, and comparing them with similar writing to be found in other parts of America, especially in the valley of the Mississippi.

A Remarkable Dwarf.—Several medical men lately visited by invitation the Mexican dwarf, Lucia Zarate, at Tony Pastor's theatre in New York. These visitors said she seemed perfect in structure,

healthy, and intelligent. She understands and talks Spanish and a few words of English. She is getting her second teeth; and although the doctors could not tell whether or not she was twelve years old, as claimed, they said she had teeth which she could not have under six years of age. She ran about, shook hands with, and talked a little to those present. She is now smaller than are many infants at the time of their birth. The following measurements were taken: Height with shoes on, 21½ inches; length of leg from hip, 10¼ inches; around head, 13 inches; circumference of thigh, 4¾ inches; circumference of calf of leg, 4 inches (one inch more than a man's thumb); length of shoe, 3 inches; width of shoe, 1⅛ inches. The parents of the child are with her, and are of the usual size: the mother is about the medium height; the father, 5 feet 5 or 6 inches in height, and quite fleshy.

The Height of British Soldiers.—In the general annual return of the British Army is a table showing the heights of the non-commissioned officers and men on the 1st January, 1875, from which it appears that on that date there were, out of 178,276 soldiers, 11,479 under 5 feet 5 inches, 23,756 from 5 feet 5 inches to 5 feet 6 inches, 35,894 from 5 feet 6 inches to 5 feet 7 inches, 36,165 from 5 feet 7 inches to 5 feet 8 inches, 28,998 from 5 feet 8 inches to 5 feet 9 inches, 19,375 from 5 feet 9 inches to 5 feet 10 inches, 11,214 from 5 feet 10 inches to 5 feet 11 inches, 5,814 from 5 feet 11 inches to 6 feet, and 3,905 6 feet and upwards. 1,676 are returned as "not reported." Of those "6 feet and upwards," 749 belonged to the Household Cavalry, 180 to the cavalry of the Line, 870 to the Royal Artillery, 106 to the Royal Engineers, 463 to the Foot Guards, 1389 to the infantry of the Line, 63 to Colonial Corps, 31 to Army Service Corps, and 54 to Army Hospital Corps. The proportion of 6 feet and upwards men per 1,000 was 22, and of those under 5 feet 5 inches 65 per 1,000.

Boys and Girls.—M. Bertillon has communicated to the Paris Society a curious statistical observation on the relative numbers of male and female births, derived from Austrian sources. The number of cases in which the first child of a marriage was male was 110 to 100 where it was female; while the number of cases where the first illegitimate child of a woman was male was only 103 to 100. On the other hand, the males in second and subsequent children in wedlock were 105 to 100; and out of wedlock, 106 to 100.

Civilisation for Africa.—Mr. Stevenson read a paper before the British Association on the proper steps to the civilisation of South-Eastern Africa. He treated the subject under three heads—Missionary, Commercial, and Governmental. He referred to the Free Church Institution for the Caffres of Cape Colony at Lovedale, to show how the place had increased in industrial education and religious training. On a call being made for assistance to carry on a new mission in the interior, fourteen natives volunteered, and six had been selected to be the native contingent at Livingstonia, at Cape Maclean. Several gentlemen settled at the mouth of a fertile valley with anchorage for small vessels before an island opposite.

A steamer fifty feet in length was successfully conveyed to and launched on the lake. The steamer could be taken down into portions, not too heavy to be carried by the natives on their shoulders. Mr. T. D. Young, R.N., had organized a corps of 400 natives for that purpose, and had the vessel carried to its destination over sixty miles of rough

porterage. This successful operation gave command to the mission party of a coast line 350 miles long.

Mr. Stevenson referred to several other missions which had been successfully established. The point was worth considering—whether in the event of the slave-trade being stopped, the Arabs might be expected as hitherto to carry on the trade of Central Africa under improved conditions. Probably the late events in Turkey might lead to the opinion that the less the Mahomedans were trusted the better.

As to the abolition of the slave-trade, at present large caravans of slaves passed across the ferries to the south of the Lake Nyassa, to the number, it was estimated, of 20,000 slaves per annum. That these should pass the British flag flying on a Mission steamer, or within a few miles of the settlement, was very painful. There seemed no reason why our Government, which used strong measures on the ocean, should stop short at the inland waters. If a cordon were drawn which would allow no slave trade to pass from the entrance of the Zambezi to the north of the Tanganyika, it would certainly settle all the country to the eastward of the line.

Telegraphy was one of the industries taught at Lovedale, and there seemed no reason why the Mission colonies should not be connected by the wire. The proposal of a cordon had already been considered, with approval, by some whose opinion was entitled to respect.

What We Once Were.—Mr. Alfred Russell Wallace, the president of the Biological Section of the British Association, in his opening address warned his hearers that they were not to imagine that the science of biology, non-existent twenty years ago, had now been perfected, and all its conclusions placed beyond dispute. Mr. Darwin's greatness lay not in his infallibility, but in the fact that he made possible the study of nature as a unity, an organic whole. This was a title which no future discovery could take away from him. Mr. Wallace admitted that the author of "The Descent of Man" often generalised hastily, but urged that his work was nevertheless of incalculable value.

Passing to his own views, Mr. Wallace refused to believe that brilliancy of colour had a great deal to do with the production of species, though he admitted that it had been proved that some animals distinguished colours. His own opinion was that locality had a great deal to do with colour, and he supported that theory with a number of very interesting facts, contending earnestly for the antiquity of man, but yet denied that the ape was our grandfather. "Man," said he, "has probably been developed from a common ancestor with all the existing apes, and by no other agency than such as have effected their development." In other words, the ape, as a species, is cousin to the human race, not its progenitor.

Mr. Wallace also contended for another doctrine, the degeneracy of the race as well as its development. Taking the Pyramids as his text, and Mr. Piazzi Smyth's investigations regarding them as the groundwork of this theory, he declared that there was evidence to show that many of our existing savages are the successors of a higher race, who probably derived their arts from a common source, but all these matters, he concluded by saying, were speculative. It was impossible to suppose that we had so rapidly leaped from total ignorance to perfect knowledge.

Old Age.—The obituary of the *Times* of March 28th contained some extraordinary illustrations of prolonged existence in nine persons —viz., five ladies and four gentle-

men, whose united ages amounted to 773 years, giving an average of 85 years and more than ten months to each. The oldest, as usual, was a member of the fair sex, who had reached the great age of 93, the youngest being 84 years of age. Of the gentlemen, the oldest was 87 and the youngest 80 years of age. The following were their respective ages—viz., 80, 81; two at 84; 85; two at 87; 92, and 93. The same obituary contained the deaths of eleven septuagenarians, whose ages averaged 73 years and nine months each.

The Eye of Man in the Future.—Science gives us interesting details about what the human eye has been and what it may become. The Vedas of India, which are the most ancient written documents, attest that in times the most remote, but still recorded in history, only two colours were known, black and red. A very long time elapsed before the eye arrived at the perception of the colour yellow, and a still longer time before green was distinguished; and it is remarkable that in the most ancient languages the terms which designated yellow insensibly passed to the signification of green. The Greeks had, according to the received opinion now, the perception of colour very well developed; and yet authors of a more recent date assure us that in the time of Alexander, Greek painters had for fundamental colours only white, black, red, and yellow. The words to designate blue and violet were wanting to the Greeks in the most ancient times of their history; they called these colours grey and black. It is thus that the colours of the rainbow were only distinguished gradually, and the great Aristotle only knew four of them. It is a well-known fact that when the colours of the prism are photographed there remains outside the limits of the blue and violet in the spectrum a distinct impression, which our eyes do not recognise as a colour. According to physiologists, a time will come when the human eye will be perfected, so as to discern this colour as well as the others.—*Medical Press & Circular.*

Primitive Agriculture.—A paper on "Primitive Agriculture," by Miss A. W. Buckland, was read before the British Association. We can only state her general conclusion that cereals were introduced by pre-Aryan races of common descent over a very wide range of the world; and they also introduced the worship of the moon as an agricultural deity. The absence of agricultural implements in prehistoric remains proved their extreme simplicity; probably only a pointed stick was used, a form still persistent. Some of the stone celts may have been used as hoes, and flint flakes might also have been inserted in wooden frames for use as harrows. Furrows and ridges seemed to have been everywhere used.

Prehistoric Remains found near Londonderry.—Mr. W. J. Knowles, of Belfast, at a meeting of the British Association, gave an account of the prehistoric discoveries made at Port Stewart, near Londonderry. They were found in pits excavated by the wind among the sandhills. The remains included arrow-heads, scrapers, hammers, flakes, bone implements, and bones of the horse, ox, pig, dog, &c., together with edible shells, all mixed up together, and apparently of the same age. As late as the 20th of July, the author and two companions had found, in less than four hours, three arrow-heads, two beads, thirty or forty scrapers, and several hammer-stones, as well as bones which bore marks of cutting or sawing. One of the most interesting of recent finds was about a dozen very small stone beads, found within a few yards' radius. They were con-

cave on one side and convex on the other. Mr. Knowles had tested the cutting power of the flint implements on a common beef-bone, using a little water, and he found that he cut through into the hollow of the bone in fourteen minutes; he had also bored a hole through a bone with a piece of flint. The marks made by the flints on recent bones were very similar to those found on the ancient bones.

With the Natives of New Guinea.—Mr. Octavius Stone read a paper before the British Association "On his Recent Journeys in New Guinea." The island, he said, extended in a south-easterly direction for a distance of over 1,400 miles, having a maximum width of 450 miles and a minimum of only 20. The neighbourhood of the Baxter River and the entire shores to the west of the Papuan Gulf for an average of 100 miles inland were low and more or less swampy, being intersected by water-courses and covered with forests of mangrove trees. This part of the country was thickly populated by the Dandé Papuans, who in consequence were subjected to periodical raids from the adjoining islands of Borgu, Saibai, and Daun, the invaders generally returning victorious with the heads or jawbones of their slaughtered victims. The only trace of cultivation he saw was eighty miles up the river, where a space of six acres had been neatly fenced round, and planted with yams, taros, sugar-cane, and tobacco. Outside the enclosure were two or three uninhabited bark huts, which appeared to afford shelter to these roving people, in which they prolonged their stay, as game was more or less plentiful.

Traces of wild boar and kangaroo were observed in the Upper Baxter. No other large animal was known to exist. They were hunted with the bow and barbed arrow, while the war arrows were poisoned by steeping in the putrid carcase of a victim until sufficiently saturated. The district of the Baxter River contrasted strikingly with the Fly River discovered by Capt. Evans, whose banks for sixty miles swarmed with human beings.

Mr. Stone's impression of the western coast was that it would prove a grave to such Europeans as should choose to reside there. This part of the country was inhabited by the Papuan race, a dark race of people, though not so dark as the Australian negro, and one of cannibal propensities. The Eastern Peninsular, on the other hand, was inhabited by the Malay race. Of this race Mr. Stone thought they had come to New Guinea from islands further east, some of them making the change at a comparatively recent date. This race was far above the savage, both in intellectual and moral attributes. They were cultivators of the soil—each having his own plantation—and strongly opposed to the cannibalism and polygamy which obtained among their western neighbours, the Papuans. The women, too, of the Malay race were not debased as among the dark race, but mixed with the men, with whom they shared the management of public affairs.

The Owen Stanley mountains ran through the centre of the country, from south to north, and the east country was on the whole favourable to cultivation, and probably possessed great mineral wealth. It accordingly offered sufficient inducement for colonisation, but colonisation, if attempted, would require to be set about with much previous consideration, owing to the peculiar situation of the peninsular and the circumstances of the people.

In the Hill Country of Ceylon.—Mr. Bertram F. Hartshorne, late of H. M. Ceylon Civil Service,

read a paper before the British Association entitled "The Rodiyas of Ceylon." The people treated of in his paper were a numerically small race, living in various isolated communities in the hill country of Ceylon. Their caste is the very lowest, and they have from time immemorial been regarded by the Singalese people with disgust and abhorrence, their very name implying the notion of filth. The popular belief has commonly considered them to be either in some way connected with the Weddas, an aboriginal race of the highest caste, or else to be outcast Singalese or ostracised Kandyans. There appears, however, to be no real ground whatever for either of these theories—the features of the Rodiyas, as well as their general *physique* and their craniology, marking them out as a separate and distinct race, no less than their customs and language. Their customs are distinguished by peculiar funeral ceremonies, and by sacrifices offered to two sorts of devils in cases of serious sickness; and their language, which is now in one of the last stages of decay, is of unknown origin and development, and can neither be classified as Aryan nor Dravidian. In all probability it represents the remnants of a more complete and extremely ancient language, although it possesses no separate alphabet, nor any literature.

The earliest historical mention of the Rodiyas apparently occurs in the year 437 B.C., and they are expressly referred to by name in the year 204 B.C., and again in the year 589 A.D. in the ancient Singhalese chronicles. The condition of the people, however, has at all times been degraded, notwithstanding the fact that the males are invariably possessed of a fine *physique*, and the females are considered to be handsome.

The peculiar social disabilities which have been imposed upon the Rodiyas by the uses of ages are now rapidly disappearing with the advance of civilisation, whilst at the same time the idiosyncracy of the people themselves, as well as their customs and their language, is gradually becoming merged in the more modern type of their Singalese surroundings.

Mesmerism at the British Association.—At the meeting of the British Association in September, Professor Barrett read a paper "On some phenomena associated with normal conditions of mind," having special reference to mesmerism or induced somnambulism. He observed that at one time it was customary for scientific men to deny the truth of the papers concerning mesmerism, and to turn the whole phenomena to ridicule, but now this prejudice had disappeared, and no better illustration of that could be found than in the case of Dr. Carpenter, who, in his last work, remarked that so far from these phenomena being absurd or incredible, they were simply manifestations of a condition of which we may frequently detect very close approximations within our own knowledge.

Professor Barrett gave the result of some experiments which he and a friend made. They mesmerised a girl and they found that no sensation was experienced unless accompanied by pressure over the eyebrows of the subject. When the pressure was removed, the girl fell back in the chair utterly unconscious, and had lost all control over voluntary muscles. On reapplying the pressure she answered readily, but her acts and expression were capable of wonderful diversity, by merely altering the place on the head where the pressure was applied. He mentioned these facts to ask whether a careful and systematic study of them might not throw

some light on the localisation of the functions.

On another occasion the subject became keenly and wonderfully sensitive to the voice or act of the operator. It was impossible for the latter to call the subject by her name, however inaudibly to all around, without eliciting an immediate response. Even when the operator left the house and called the girl's name she still responded more and more faintly as the distance became greater.

Dr. Carpenter had stated that he had seen abundant evidence that the susceptibility of subjects mesmerised might be exalted to an extraordinary degree, this being due to a concentration of the whole attention upon the object which excited them, and speaks of a youth having known the possession of a ring by the scent, and of a case in which the slightest difference of temperature had been detected.

Professor Barrett quoted a case which had come within his own knowledge, in which a girl who had never been out of a remote Irish village described Regent-street, in London, while he himself was thinking of it, and told him the English time on a clock in London. This had led him to the conclusion that a distinct conviction in the operator's mind gave rise to a similar idea in the subject's mind.

Before these phenomena could be accepted unreservedly we must have more evidence, but it was not wise to put forward incredulity as a barrier to the possible extension of our knowledge. The Professor then referred to spiritualistic phenomena, and presented new and wonderful facts which must sooner or later compel the attention of thoughtful men.

In the discussion which followed, Colonel Lane Fox gave results of his experiments among the members of his own family, which he had carried on for the last four years, stating that his eldest daughter's presence was indispensable for the manifestations.

Lord Rayleigh said he had seen enough to convince him that those people were entirely wrong who wished to prevent investigation by casting ridicule on those who might feel inclined to engage in it.

The Rev. Mr. M'Ilvaine considered the evidence which Professor Barrett had brought forward altogether unreliable, consisting, as it did, mainly of the testimony of young girls.

Mr. Hyde Clark held that the question could only be settled by experimental facts being brought forward and discussed.

The President stated that he had himself produced the phenomena of mesmerism which could not be accounted for by any preconceived idea; indeed, in one case the effects of passes made by himself had lasted for a considerable period and without the possibility of any deception. People spoke of requiring more evidence, but he thought the phenomena which had been produced were certainly worthy of careful inquiry. He recommended the appointment of a Committee of scientific men to investigate the subject.

Dr. Carpenter said there was a curious power in some persons which might be called thought-reading, and he urged further investigation.

Ornamental Callings in British India.—Among the natives of British India engaged in professions, we find, according to the recent census, 636 described as authors, including 518 poets, and 1 dramatist in the Madras Presidency; 1 speech-maker in the North-West Provinces, and 87 editors in Madras, Calcutta, and Dacca. The astronomers number 130, and included in the list of persons occupied in education, literature, and art, is a set called "Ca-

lendar Brahmins," who are almanac or pedigree-makers and fortune-tellers, exceeding 23,000 in number. Among those engaged in religious occupations are classed 30,000 pilgrims, devotees, and religious mendicants, 10,000 astrologers, 5 wizards, and 465 devil-drivers. The fine arts are recorded as engaging the attention of 218,000 persons, including nearly 8,000 painters, sculptors, and photographers. Almost all the others are votaries of music in some shape, though their claim to be artists is very doubtful; they number 167,000. Of actors, jugglers, and acrobats there are 38,600, including 75 jesters and 29 mimics, 221 wrestlers, 15 buffoons, 15 monkey dancers, and upwards of 1,000 snake charmers. The bards number 4,400, chiefly in the North-West Provinces and the Punjab.—*Academy.*

The first Chinaman of learning in Europe.—A news letter from London, dated July 19th, 1687, among some seventeenth century documents acquired lately by the MS. department of the British Museum, contains the following account of a remarkable visitor to our island at that time:—

"I have been somewhat busy in showing the civilities of the court, city, and country to a Chinese lately come over, who is the first man of learning of that country that ever was known to have come into Europe. His Majesty was pleased to be very civil to him himself, and did not only give me his royal example, but did lay his commands on me to do so. and do all the friendly offices I could, by letting him see what was most proper to satisfy his curiosity by. He came out of China about six years ago in the company of some of the missionary Jesuits, and stayed four of them in Italy, the other two in France and Flanders."

Papuan Bows and Poisoned Arrows.—The warlike habits of the Papuans and their implements of warfare are described in a private letter recently addressed to Dr. Hooker. The writer says that no man leaves his dwelling, for his bit of cultivation even, without his powerful bamboo bow and a few deadly poisoned arrows. These poisoned arrows are only a few amongst a number not poisoned, the former being distinguished by elaborate carving and painting, probably to prevent accident amongst themselves. They are each pointed and barbed with human bone brought to almost needle-like sharpness, most carefully and neatly finished; they are poisoned by plunging in a human corpse for several days. Poor Commodore Goodenough and his men suffered from arrows so poisoned. It is a sort of blood-poisoning that, like other kinds of inoculation, does not develop itself for several days, the slightest scratch being sufficient to render almost inevitable a horrible death. The symptoms are accompanied by violent spasms like tetanus, with consciousness to the last.—*Nature.*

Certified Mediums.—Not to be behind more mundane personages, the supposititious spirits which are so successfully befooling weak-minded mortals have deemed it necessary to issue diplomas for the distinguishing, in the interests of the human race, true from false mediums. But here is a difficulty: the spirits undertake to guarantee the mediums, but who will guarantee the spirits? We do not know whether any English mediums have as yet been honoured by diplomas. Our information is from Russian sources, and specially relates to a certain Russian medium, M. Sidoroff, who died not long ago. Among his papers his executors found the diploma of which the following is a translation:—"Re-incarnation and evocation of spirits; No. 11.—Continuity of life from age to age and world to world.—Diploma: The Legion of

Spirits, recognising your ardent and unlimited zeal for the science which reveals the mysteries of the supernatural power of spirits, consecrate you a medium, in order that you may serve as a link of union between the material world and the immaterial world, and may transmit to the profane, manifestations from the spirit world. In token whereof the present diploma is conferred upon you.—Paris, Jan. 1, 1876.—Renard, Great Pontiff: Gizo, Secretary.—Conferred upon Apollon Sidoroff." How it comes to pass that a Paris mediumistic circle should have been inspired to constitute itself a university for the issuing of spiritual diplomas will be no mystery to those who are familiar with the progress of mystical studies and speculation in France of late years. —*The Lancet.*

Californian Legends.—In Central California the story is that in the beginning the world was dark, so that men and beasts and birds were always stumbling and dashing against one another. The hawk happening to fly in the face of the coyote (prairie wolf), they mutually apologised, and set to improve things. The coyote made balls of reeds and gave them with some pieces of flint to the hawk, who flew up into the sky with them and set them alight. The sun-ball still glows red and fierce, but the moon-ball was damp, and has always burnt in a feeble, uncertain way. The Southern Californians, on the other hand, believe that the sun and moon were the first man and woman; women, descendants of the moon, are fair but fickle, for as she changes so they all change, say these savage philosophers.

All from one Source.—He who carefully examines the myths and languages of the aboriginal nations inhabiting the Pacific States, cannot fail to be impressed with the similarity between them and the beliefs and tongues of mankind elsewhere. Here is the same insatiate thirst to know the unknowable, here are the same audacious attempts to tear asunder the veil, the same fashioning and peopling of worlds, laying out and circumscribing of celestial regions, and setting up spiritually and materially of creators, everywhere manifest. Here is apparent what would seem to be the same inherent necessity for worship, for propitiation, for purification, for atonement and sacrifice, with all the symbols of natural and artificial religion. In their speech the same grammatical constructions are seen, with the usual variations in form and scope, poverty and richness, which are found in nations, rude or cultivated, everywhere. Little as we know of the beginning or end of things, we can but feel, as fresh facts are brought to light, and new comparisons are made between the races and ages of the earth, that humanity, of whatever origin it may be, or however circumstanced, is formed on one model, and unfolds under the influence of one inspiration.

The Irish in Great Britain.—There are no less than 9·46 of the population of the principal towns of Scotland, 2·80 per cent. of that of London, and 4·93 per cent. of that of sixty other towns, consisting of natives of the Green Isle; and if to these were added the children of Irish parentage born in these kingdoms, and consequently figuring in the Census returns as natives of Great Britain, their numbers would at least be trebled.—*Geographical Magazine*

A Missing Link.—What is called a singular "phenomenon" is noticed by the *Philadelphia Ledger*, and is creating quite a "sensation" a few miles from Erie, Pennsylvania, in the shape of a mouse-catching infant, surpassing in expertness the most agile cat in the country. This extraordinary child is a little girl

about a twelvemonth old, who, the moment she awakens from her slumbers, crawls out of her crib to the old kitchen fireplace, which is infested with a species of small house mice, and over a hole in the corner baby crouches with her eyes like those of a cat intently fixed on the orifice. She sometimes occupies this position for an hour without moving till a mouse makes its appearance, when, with a sudden pounce, baby seizes her victim by the neck. As soon as the prize is secured she seems to be electrified with joy, and trembles from head to foot, uttering a kind of wild murmur or growl resembling the half-suppressed snarl of a wild cat. The mouse, when once out of its hole, seems magnetised, and makes no attempt to escape. If any one attempts to take the mouse away from the baby, or even approaches her with this object, she at once conceals her prize by placing it in her mouth. The charm of infancy would be greatly enhanced if all babies would make themselves as useful as this sweet Pennsylvanian child.—*Pall Mall Gazette.*

Curiosities of Human Automatism.—Dr. Carpenter, at the London' Institution, delivered two lectures during the winter, on "Human Automatism." In his first lecture he illustrated reflex action, that unconscious repetition of an habitual process on the recurrence of the impressions which once caused the action to be consciously made. An impression is conveyed from the surface to the nervous centre, and thence without other intervention a message passes along the motor nerves and calls the muscles into contraction.

He showed in his second lecture how respiration and all but the beginning of taking food are as a rule unconsciously performed, but, nevertheless, are more or less under the control of the will when it wills to direct them. The mind he likened to a rider, which guides but does not supply the motor force of the body bestridden; and he quoted Xavier de Maistre's division of a man into animal (*bête*) and soul (*âme*)—a distinction which, it may be remembered, has been felicitously adopted by Mr. Tennyson in his well-known line about the brute's soul within the man's.

Dr. Carpenter continued that a child digging up the common centipede in a garden finds its body, divided by the spade, still moving in both morsels. Instead of the vertebral continuity of man, a diagram of the centipede shows many little knots, or ganglia, each of which is a nerve centre. Each may thus become a centre of activity, and the creature may be split up into as many moving morsels as it has ganglia. There is no reason to believe that when the head is off, the other morsels have sensation, but they continue to move by ref or unconscious action. The mantis, which from its suppliant arms has gained the epithets of *religiosa*, *prie-dieu*, and a corresponding name in Arabic, holds out these limbs till it clutches the insect which is its prey. Cut off the body below the arms, it still clutches its food by reflex action, though there is no reason to believe it has any feeling whatever. Touch the lower part of the divided body it flutters violently, although we have every reason to believe, from the analogy of ourselves, that when the head is off there is no sense left. A man falls from a mast and injures his back. He is brought into hospital with complete paralysis of the lower limbs. He cannot m them by any effort of the will. Tickle the soles of his feet, he will draw them up violently, but know nothing about it. There is every reason to think the spinal marrow may act in almost any habitual mode without any consciousness whatever. A man was recently brought into

a London hospital for apoplexy, and died in thirty-six hours, without any sign of returning consciousness; but during the whole of that time he was continually carrying his hand towards his moustache and giving it a pull and a twirl. It was found on inquiry that he was a retired military man, who took a pride in his moustache, and was often laughed at for his habit of twirling it. He usually did so unconsciously, and the action continued when only those portions of the spinal cord remained in activity which are in action during a profound sleep.

The movements of a frog are almost entirely of this reflex character, and though his brain (*cerebrum*) be taken out, if the *cerebellum* be left, he will climb up and over the ridge of your hand to avoid falling off, if you place him in the hand and begin to incline it. It has occurred to most on going up to dress for an evening party, to take off the watch and wind it up as if they were going to bed. A friend of the lecturer's actually got into bed under such circumstances, and a young man who went up to dress had been known to kneel down and say his prayers. We travel a known road like a well-trained horse, and in these latter cases high faculties are employed, for you must see your watch to insert the key.

The closing of the eyes upon the flash of light is a well-known instance of unconscious action. Sir Benjamin Brodie, after an explosion of chemicals held in his hand at Oxford, thought he had lost his eyesight for ever, but he found that he had immediately, and without knowing it, closed the lids, which were sown with fragments of glass, while the eyes were safe. We know that the *cerebrum* furnishes the instrumental mechanism for our mental operations.

There are trains of thought which induce others in a manner perfectly involuntary; but what we can do is to encourage trains of thought which we desire to keep up, and to repress their opposites. The process by which we do this is exactly the same process by which, for instance, we try to provoke or repress a cough. The cough is entirely automatic, but we can play downwards from the *cerebrum* and replace the mere tickling in the throat which usually calls forth a cough. The mind wills the result though it does not will the separate muscular movements. If you will to look fixedly at a clock, and, at the same time, to move your head from side to side, the eyes roll of themselves as you move your head. In each case we have to train our automaton. To play the fiddle a man must educate his *bête*, and to do mental work a man must prepare his *cerebrum*.

That is why far more importance is rightly attached to disciplining the mind than to learning particular things, though, of course, there are useful and useless knowledge. We should naturally wish our children's education to be directed to profitable things, but the question is whether there may not be things that will never be of direct use in after life, but which are invaluable as training. The foundation of all the power of using the brain is the capacity to fix the attention, the power of keeping the mind devoted to one particular set of sequences of thought. We will to keep our attention fixed, and the will has a positive and direct power of fixing attention upon one thing in exclusion of another.

Dr. Carpenter here pointed out what he called a fundamental distinction between himself and those whom he described as the automatists. They, he said, think that the strongest impression prevails, but he holds that the will makes the struggle; else why is one so exhausted by overcoming distractions?

Passing to that which he long ago

described as "unconscious cerebration," approaching it from the physiological point of view, which Sir William Hamilton, as he afterwards discovered, has called it "latent thought"—Dr. Carpenter recalled the cases in which a man tries to remember a fact. He selects from among the ideas which present themselves automatically the one that he will follow out. But supposing the fact does not turn up, then we have a curious instance of automatism. When once you have impressed upon your mind that there is something you want to get hold of, and have been puzzling over it for hours, your best plan is to leave the mind to itself, to put the reins upon the horse's back, and the lost idea will present itself without your being able to explain how. A student at Leyden (the Rev. John de Liefde, a Dutch clergyman in London, told the story) worked at night a mathematical problem he had been puzzling over for days. He slept in the same room as Mr. de Liefde, and in the morning was wholly unaware that he had got out of bed in sight of his room-companion and worked the problem, and that by a shorter method than he had tried before.

The mind worked along traces previously established, and no doubt the wonderful feats of the calculating boys were performed by an analagous process; by direct intuition rather than ordinary calculation. We might apply this to the direction of our mental course. We see this habit of fixed attention which is in the most remarkable degree the result of training; and we may begin even in the second or third year to encourage a child to keep its attention fixed for a short time while some explanation is being given. Later it becomes unnecessary to solicit this attention; but the greater the power of fixing the mind, the greater the power of self-control. Self-control is the fixation of the attention upon one set of motives to the exclusion of another set. In all cases the stronger motive preponderates, but we make for ourselves the strength of our motives by the degree in which we fix our attention upon one motive rather than another.

When we want to withdraw our minds from some feeling we ought not to entertain, we should not say, "I must not think of this," for then our attention will certainly be directed to it, but "I will not think of that." We ought to turn our minds upon something that is attractive and worthy, and, by the fixation of the attention upon that, to strengthen its attraction for us, and proportionately weaken the attractiveness of the other. How the will dominates the *cerebrum* he could not tell, but we have daily experience that it does, and our own experience and our own thoughts and feelings are far the most certain of all experience. The knowledge that we have the power of self-direction is the fundamental fact in our whole nature. "I am," "I ought," "I can," "I will," are the four words which man can say, and the saying of which divides him from the lower animals; for though a dog has a sense of duty, it is only the sense of doing what his master likes. We men reach the higher aspect of moral right and wrong. "I can" implies "I can do as I ought." Therefore, although he went entirely with his friends in asserting the automatism of the animal and mental mechanism of man, he held that was not all. The state of sleep and somnambulism, all the curious induced states of somnambulism, are so completely divided from the state of the man who has his mind "well in hand," as it may be said, that he could not see how it was possible to deny the fact that we have a controlling and directing will.

II.—THE ANIMAL WORLD.

How the Vulture is bald.—In the Isthmus of Panama, the *Gallinazo*, a black vulture, is a very familiar object. You see it everywhere, perched on the houses and walls, or walking about in the streets and over heaps of refuse. It renders great service in cleaning the streets, removing carrion, &c., and there is no need of any law to protect it. The Gallinazo is of a uniform black, but its head and neck are entirely devoid of feathers. The inhabitants of Panama have a reason to give for this baldness. At one time, they say, the gallinazo had feathers on its head. After the deluge Noah, on opening the door of the ark, thought it well to give a word of advice to the released animals. "My children," said he, "when you see a man coming towards you, and stooping down, go away from him; he is getting a stone to throw at you!" "Very good," exclaimed the gallinazo, "but what if he have one already in his pocket?" Noah was somewhat taken aback at the reply, and decided that in future the gallinazo should be born bald, in token of its remarkable sagacity!—*Les Mondes.*

Spare the Toad.—The toad, almost universally despised and upbraided for his ugliness, is yet a useful, good-natured, quiet fellow, who recognises his friends, and those who are kind to him. We have some half-dozen of them in our small garden, and anong them one old patriarch, who, when we are digging or hoeing, will sit winking and blinking-at us with his pretty eyes, and often compel us to lift or drive him aside to get him out of harm's way. It will stay by us for hours, evidently feeling that he need fear no hurt. Like the sparrow, the toad has been considered a nuisance, and, in some sections, has been exterminated; but the exterminators have only been too glad afterwards to get him back by the expenditure of large sums of money. So useful are toads in gardens that they are sold in France by the dozen for the purpose of stocking gardens to free them from many injurious insects. The toad lives almost entirely on winged insects, and never does harm to the plant.—*American Garden.*

Sea-birds in France.—The causes of disappearance of sea-fowl from the French coasts have been inquired into by M. Gonezel, of Nantes. The shooting of sea-fowl is permitted all the year round, and no attention is given to destroying the birds which prey on them; moreover the fishermen collect large quantities of eggs in the hatching season, to make omelettes. The sea-fowl acts, however, beneficially by feeding on the débris of fishes thrown upon the shore, and which would otherwise, in time, become centres of infection. Its presence warns the navigator of the nearness of land, and the presence of rocks not indicated by lighthouses, also of bad weather. It reveals to the fisherman the banks where fish are to be had, and particular kinds of fowl announce particular kinds of fish. It is a mistake, then, M. Gonezel thinks, to class gulls, and the greater number of palmipedes among injurious animals.

Wild Beasts in India.—The destruction of human life by wild animals in the Indian Central Provinces during 1875 was considerable.

In six months 617 persons lost their lives, and 3,536 head of cattle were destroyed. During 1875, 198 tigers, 635 leopards and panthers, and 886 other wild beasts were killed in the Central Provinces, at a cost to the Government of over 1,350*l.*

Tree Frog's Eggs.—Professor Peters has lately described the mode of deposit of its eggs employed by a species of tree frog (*polypedates*) from tropical Western Africa. This species deposits its eggs, as is usual among batrachians, in a mass of albuminous jelly; but instead of placing this in the water, it attaches it to the leaves of trees which border the shore and overhang a water hole or pond. Here the albumen speedily dries, forming a horny or glazed coating of the leaf, enclosing the unimpregnated eggs in a strong envelope. Upon the advent of the rainy season, the albumen is softened, and with the eggs is washed into the pool below, now filled with water. Here the male frog finds the masses, and occupies himself with their impregnation.

A wise old Baboon.—A French correspondent of *Les Mondes* relates the following curious incident. The coffee plantations of the Transvaal Republic are much exposed to the ravages of large cynocephalic apes, and a guard has to be kept in order not to lose, through these animals, the fruits of long labour. Among the coffee trees grows a shrub, the fruits of which are borne very close to the trunk. A species of wasp had chosen several of these shrubs to attach their nests to, and the baboons had often been observed casting envious glances towards the fruit, but not daring to touch it. One fine morning the planter heard terrible cries, and, with a good opera-glass, he witnessed the following scene: A venerable baboon, chief of the band, was laying hold of young apes and pitching them into the shrub, and he was doing this again and again, spite of the most piteous cries and groans. The shock brought down the nests of the wasps, which attacked the poor victims in swarms, and during this time the old wretch proceeded quietly to feed on the fruits, deigning occasionally to throw the remains to some females and young ones a little way off.

Ostrich appetites and Ostriches' nests.—The domestication of ostriches in Cape Colony—now successfully carried out—has enabled many curious facts to be ascertained. One is that the ostrich subsists exclusively on grain and herbs. It swallows occasionally pieces of metal and stones, and it is this habit which has given the bird the reputation of voracity, and of even being carnivorous, which is not true. It is also well known, of course, that the ostrich forms for itself a nest like other birds, in which it lays its eggs, sits on them, and does not leave them to the sun to hatch, as had been supposed by the older naturalists.

Threads from Spiders' webs.—Cobwebs have been applied to various uses. The delicate cross hairs in the telescopes of surveying instruments are fine webs taken from spiders of species that are specially selected for their production of an excellent quality of this material. The spider, when caught, is made to spin his thread by tossing him from hand to hand, in case he is indisposed to furnish the article. The end is attached to a piece of wire, which is doubled into two parallel lengths, the distance apart exceeding a little the diameter of the instrument. As the spider hangs and descends from this, the web is wound upon it by turning the wire round. The coils are then gummed to the wire and kept for use as required. About a century ago, Boa of Languedoc succeeded in making a pair of gloves and a pair

of stockings from the thread of a spider. They were very strong, and of a beautiful grey colour. Other attempts of the same kind have been made; but Réaumur has stated that the web of the spider was not equal to that of the silkworm either in strength or lustre. The cocoons of the latter weigh from three to four grains, so that 2,304 worms produce a pound of silk; but the bags of the spider, when cleaned, do not weigh above the third part of a grain.

What is Honey?—Dr. Reicheneau has been engaged in an inquiry as to whether honey and other industrial products of the bees are obtained directly from the food of the insects, or are products elaborated by the organism. He has not completed his researches, but, as of three albuminoid, nitrogenous substances found in the honey, one, coagulable by heat, does not occur in the juice of the flowers, he infers that it is a true secretion by the bee, which becomes mixed with the nectar. Honey is, therefore, strictly a nitrogenous body, and not simply a carbo-hydrate. In purified beeswax nitrogen was found to the extent of 0·597 per cent.

Horses' Brains.—On the subject of horses Mr. Buckland has made some interesting observations. They hate solitude, and are made savage by being kept alone. Goats ought always to be kept in stables, because they will face fire, and horses will follow them out, though they will not go by themselves. The larger-brained horses are the cleverest. In the 2nd Life Guards the horses with broad foreheads learned their drill more quickly than the others. A gentleman at Mr. Buckland's instigation measured the heads of all his hunters, and found that their intelligence and good sense was in proportion to the width of their foreheads.

Eating Kangaroos.—In the Jardin d'Acclimatation, Bois de Boulogne, Paris, are some hundreds of kangaroos, recently arrived from Australia. The kangaroo has been introduced into several estates in France, and is now hunted in that country like other game. The flesh is sold in the market, and is thought a great dainty.

Life in Ocean Depths.—Mr. J. Gwyn Jeffreys, F.R.S., at the meeting at Glasgow of the British Association, gave an account of the biological results of the voyage of the *Valorous* to Disco Island in 1875. He urged the importance of repeated expeditions of this kind. A century of hard work would not suffice to collect all the information that was needed. Hitherto naturalists had only scraped the bottom of a few acres out of the many millions of square miles of the ocean. The British nation had hitherto done very little for submarine discovery in proportion to the poorer countries of Scandinavia, which had sent out expedition after expedition, yielding the most valuable results to science. An important result of Mr. Jeffreys' experience was the bringing up of large and small stones, some very sharp, from the sea-bottom, at great depths. He thought telegraphic engineers had not taken this sufficiently into account in the construction of cables, having proceeded as if they had only to deal with an entirely soft bottom. The number of species of mollusca obtained by the *Valorous* was 183, of which forty were new to science. His opinion, derived from personal knowledge of the American, as well as of the European fauna, was, that the submarine fauna of Davis' Straits was predominantly European, although a number of American forms were found with them. An interesting feature was the discovery of a number of species previously only known in a fossil state in Tertiary rocks

far distant, as in the Mediterranean; other species were remarkable because it was now for the first time shown what an enormous range in space and latitude they had, sometimes at least 1,200 miles.

Cobra Poison.—Cobra poison has been analysed by a member of the Calcutta Presidency College, and has been found to bear a close resemblance in its chemical constituents to albumen, the innocent substance which forms the white of an egg. "It is more than possible," says the analyist, "that the poison is a mixture of albuminous principles with some specific poison.—*Graphic.*

A Use for Carrier Pigeons.—Mr. Tegetmeier, in a lecture at the Zoological Gardens on the "Carrier Pigeon," strongly urged the expediency of keeping carriers on board the lightships all along the coasts, and showed, by means of a map and diagram, that every soul on board the *Deutschland* might have been saved had the crew of the lightship only had a carrier-pigeon, under whose wing news of the ship's perilous position might have been sent into Harwich.

Birds for New Zealand.—Mr. Frank Buckland, the naturalist, says that, of nine kinds of British birds sent out to New Zealand, the hedge-sparrows did the worst on the voyage, only 11 being landed alive out of 140. Of the starlings only 33 out of 100 reached the land of exile. But most of the others stood the voyage well. Of the partridges about three-fourths lived; of the blackbirds and thrushes, 190 out of 200; of the linnets, 95 out of 100; while, out of 180 yellowhammers, 110 goldfinches, and 120 redpoles, not one was lost.

An Unexpected Passenger.—Mr. Frank A. Nash gives the following account of an interesting event which occurred at the London Docks in the beginning of June, being the capture of a large boa constrictor, on board the ship *Surprise*, just arrived from Port Natal, laden with wool and hides:—

It appears that while at the port she went within the bar to load, being a small vessel, and consequently was close to the bush. One evening, after her cargo had been shipped, while the crew were having a little jollification among themselves, one of the sailors, who happened to possess a concertina, was playing various tunes for the amusement of his companions. It is supposed that the music attracted the "boa" on board, and being disturbed it must have found its way into the hold, as the hatches were off at the time, and concealed itself among the cargo, as it was not discovered till the ship was well on her voyage home. When she arrived in dock the question arose as to how it was to be captured, but, with the assistance of Mr. Jamrach, this was successfully accomplished. The reptile is about eight or nine feet in length, and as thick as the calf of a man's leg. It had existed during the voyage on rats and other vermin, with which the vessel swarmed while at Port Natal, and now there is not a rat to be seen in any part of the vessel, so that in future it may be thought desirable to ship a boa constrictor instead of other animals to catch rats and such small deer.

Making Pigs Move On.—Pigs are not of an accommodating disposition, and where a waggon-load of them have to be got out over a narrow gangway, the first ones that start on the plank are apt to decline to proceed further, and so block the egress of the rest. This will often long delay a cattle train, and occasion a vast amount of beating as well as bad language. The cattle-yard men at West Albany, New York (according to the *Scientific American*), remedy the evil by a simple and somewhat comical device, termed

the "hog-bouncer." One end of the gangway plank is brought to a firm support; then under the other end two double car springs are attached. A powerful lever and a spring catch complete the device. Before the waggon door is opened, the platform is carried down so as to compress the springs of the lever, and the catch is hooked. The hogs are then allowed to pass along the platform, and so long as they move on properly, the plank is undisturbed; but as soon as a crowd congregates, and vociferously object to going further, the catch is sprung. One end of the platform flies about three feet upwards, and the result is a shower of living porkers shot over the heads and upon the soft bodies of the drove. They are seldom injured, but vastly astonished, and it is needless to add that the blockade is at once dispelled. The drovers find this device, ridiculous as it appears, very useful in saving time and trouble.

What Dogs are Good For.—It is a fact, perhaps not generally known, that there is a firm doing business in San Francisco who purchase the thousands of dogs slaughtered by the poundmaster of that city, or that may have been otherwise killed, for which they pay forty cents each. The carcases are conveyed to their manufactory at South San Francisco, where the skins are removed and sold to the tanneries, the hair taken of and resold to plasterers, the hide tanned, made into gloves, and sold in the market. The denuded carcase is then thrown into a huge cauldron and boiled until the bones are easily separated from the flesh, when they are removed and sold to the sugar refineries, where they are ground to a fine powder and used to clarify sugar. The oil that rises to the surface of the boiling mass is skimmed off and manufactured into cod-liver oil, and the remainder is used for the purpose of fattening hogs.

A Use for Locusts.—A means of utilising these insects has been devised by a French physician, Dr. Morvan, of Douarnez, Finistère, and consists in preparing them in different ways as bait for fish. In America, where swarms of grasshoppers often do serious mischief, devastating large tracts of country, traps have been devised for catching these insects; but, except in a few instances, where they have been used for manure, they have not been made to serve any useful purpose. Dr. Morvan dries the locusts in the sun, presses them into barrels, and subsequently smashes them into a paste, which is made into small balls and thrown into the sea during fishing operations. Another method is to boil the locusts before making them into a paste. This bait is of an oily nature, and is said to be eagerly devoured by the sardine or pilchard. Large quantities of cod's roe are used on the coasts of Brittany in the prosecution of this fishery, but the increasing high price of this bait has lately been a serious addition to the expenses of the fishermen, who have eagerly availed themselves of the novel substitute. Bait is not generally used in the English pilchard or sardine fishery, different modes of fishing being adopted to those employed in France; but in those instances where cod's roe has been tried it has been found to attract large numbers of fish. The increased demand for pilchards which the operations of the Cornish Sardine Company of Falmouth are likely to create, for the purpose of preserving the fish in oil, in the manner which has found so much favour, will probably lead to the more extended use of bait, and locusts or grasshoppers will no doubt come into requisition in Cornwall, as well as in France. The experiments of Dr.

Morvan were considered so important by the French Government that a hundred barrels of locusts were supplied by the Governor-General of Algeria, and transported to Brittany, to be tried on a larger scale, at the cost of the State. The results were so very satisfactory, that during the ensuing fishing season the locust bait is expected to be largely used.—*Times.*

An Adder's Cunning.—A correspondent of the *Milwaukee Sentinel* states that, over thirty years ago, in Leeds, Greene county, New York, his attention was one day attracted by the plaintive cry of a cat. Looking into a garden, an adder was seen near the cat. The cat seemed to be completely paralyzed by fear of the adder; she kept up a plaintiff cry, as if in great distress, but did not take her eye off the serpent, or make any attempt to attack or escape. Soon the snake saw that human eyes were observing him, and he commenced to crawl slowly away. "I then," continues the writer of the narrative, "concluded to release the cat from its trouble. I took a garden rake and put it on the snake's back, and held it without hurting it. As soon as I had the snake fast in this position it raised its head, flattened it out, and blew, making a hissing noise, and something resembling breath or steam came from its mouth. When that was exhausted I removed the rake, and the adder turned over on its back, lying as if dead. With the rake I turned it over on its belly again, but it immediately turned on its back. This was repeated several times. At last it was taken out of the garden, laid in the road, and we all retired to watch its movements. It commenced to raise and turn its head slowly (looking about the while) until entirely on its belly, and started at full speed for a little pool of water in the road, from which it was raked out and dispatched."

A Walking Fish.—A singular "walking-fish" is found near Sherman, Colerado, on the line of the Rocky Mountains, and 8,200 feet above the sea-level. The fish is partially amphibious, and has four legs, which it uses when on land. In the water the legs double up, and a ring of fins round the neck stand out like a ruffle, and assist the fish to swim.

Frogs in Sandstone.—At the Shieldmuir pit, near Motherwell, Airdrie, an extraordinary discovery, says the *Scotsman*, has been made. The manager of the pit, while superintending the driving of a mine through sandstone, was surprised to find from thirty to forty live frogs issue from the centre of a mass of stone that had been dislodged. The level in which the frogs were found is three hundred and thirty feet under the surface, and the mass of stone was fully a hundred yards from the pit bottom. No fissure could be observed in the stone; and all who were present are positive that the frogs came from a cavity in the centre of the block. The frogs, apparently quite fresh after their imprisonment, at once made for a pool of water, in which element they were of course quite at home.

The end of a Wild-beast Show.—A curious miniature menagerie was recently organised in Paris by an impecunious Pole. He obtained four docile cats and coloured them yellow, adding black stripes to complete the resemblance to tigers. A little boy of about eight years old, very small for his age, was passed of as a dwarf, and shut up in a large cage with the cats, which were announced as a very rare and minute species of tigers. Boy and cats were instructed in the usual tricks of the wild-beast tamer; but one day the cats, infuriated by the chastisement they continually received, set upon the unfortunate boy, and lacerated his face and hands. The boy took refuge in the street,

where he was protected by the neighbours, and the menagerie proprietor at once decamped, leaving his property to the public.

Pigeons on the Wing.—Experiments made by MM. Laussedat and Gaston Tissandier have shown that a pigeon liberated from a balloon at a height of 7,000, 6,000, or 5,000 metres is paralyzed in flight, and falls like an inert mass: if let off successively at heights of 1,080, 800, and 300 metres, it is precipitated towards the earth, describing long spirals. How then (asks M. de Roo, in "Science pour Tous") can it be maintained that the pigeon is guided through space by the sight? for, by a simple calculation, it appears that a pigeon will have to rise—

Metres.		Kilom.
785	to see a distance of	100
3,143	,, ,, ,,	200
7,076	,, ,, ,,	300
12,586	,, ,, ,,	400
19,688	,, ,, ,,	500

Now the pigeon which M. Cassiers transported from Chatelherault to Agen would have had to rise 7,000 metres to see Chatelherault from Agen, and we know that in these high regions the pigeon has its faculties paralysed. Sight will not explain the pigeon's strange faculty of orientation; and we must either credit it with some sense of which we have no idea, or seek the cause in certain atmospheric currents, perhaps in head currents, which pilot it towards its cote. The birds have probably an excessive atmospheric impressibility of which we have little idea; they can probably distinguish that from the north comes cold, from the south heat, from the east dryness, from the west moisture. Bird-catchers say that their work is in vain when the wind blows from the north, for the birds then conceal themselves in the crops or in the woods.—*English Mechanic.*

How to deal with Poisonous Snakes.—The deadly effect of human saliva on poisonous snakes is positively asserted by a Georgia (U.S.A.) farmer, according to the *New York Herald.* As the farmer was in a field picking up some straw, a rattlesnake four feet long fell from the straw at his feet. He set his heel on the reptile's head, and spit into its mouth. In a few moments the snake became sick and powerless, and died in a quarter of an hour. Shortly after he caught an adder, and on following out his experiment, the creature died, whilst by merely wetting a stick with his lips, and drawing it across another adder's nose the same result ensued. On spitting into the mouth of a harmless snake, however, the creature was uninjured. Anent snakes, a medical correspondent of the *Times of India* declares liquid potassæ a sure cure for snake-bite. He has tried it in several cases, and has never found it fail.

Common House-flies.—The familiar house-fly (*musca domestica*) is apt to be considered an unmitigated pest. It is, therefore, time to call attention to some recent investigations of a chemist which go to bear out the pious axiom that everything has its use. This observer, noticing the movement of flies after alighting, rubbing their hind feet together, their hind-feet and wings, and their fore-feet, was led to explore into the cause, and he found that the fly's wings and legs, during his gyrations in the air, became coated with extremely minute animalculæ, which he subsequently devours. These microscopic creatures are poisonous, and abound in impure air, so that flies perform a useful work in removing the seeds of disease. Leanness in a fly is *primâ facie* evidence of pure air in the house, while corpulency indicates foulness and bad ventilation. If these observations are well-founded,

the housekeeper, instead of killing off the flies with poisonous preparations, should make her premises as sweet and clean as possible, and then, having protected food with wire or other covers, leave the busy flies to act as airy scavengers.—*Catholic Times*.

Two Rare Birds.—The Museum of the Jardin de Plantes, in Paris, has recently been enriched by two aquatic birds of a curious species, only met with in Virginia. They are specimens of "Albatros latea." The plumage is canary yellow, and shines with dazzling brightness in the sun. The wings of the male bird measure 2·80m. across; the female is smaller, and differs also from the male in the colour of the beak, having a black one, while he has a grey. They live exclusively on fish, but their voracity is great that they do not hesitate to attack quadrupeds when in a famished state. The greater part of the fine stuff, known as Virginia barege, made from the down on the feathers of this bird.

Reasons for Rotten Eggs.—Dr. U. Gayon has been following up the investigations of Pasteur, Donné, and others, to determine the nature of the phenomena of putrefaction of eggs. Donné contends that eggs would keep good if not shaken, but if shaken they would always turn bad in less than a month. He also asserts that no matter how rotten an egg may be, no trace of any organisms will be found in it, either animal or vegetable. With regard to the latter assumption, several investigators declare it to be erroneous, and Dr. Gayon figures several organisms met with in decaying and rotten eggs. Accepting the presence of these organisms as proved, and the evidence is very convincing, the question arises, how did they get there? It is generally supposed that the germs enter through the pores of the shell; but Dr. Gayon is of opinion that the germs exist in the egg when it is laid. In examining the oviduct and cloaca of several hens he found the same organisms, and it appears that they are more abundant in fertilized eggs than in sterile. It was also proved that when an injection containing numerous Bacteria was used they were more numerous in the eggs that followed. The fact that the presence of various foreign bodies in eggs, such as portions of insects, small stones, seeds, &c., has been attested by numerous observers, favours this view. Dr. Gayon found germs of alcoholic yeast in the egg of a hen fed upon the refuse from a brewery. Further, Dr. Gayon affirms the statement that moulds are not the cause of putrefaction in eggs. A long series of experiments demonstrated that the act of moving or shaking an egg has little or nothing to do with causing its decay. It seems far more probable that it depends to a great extent upon the nature of the food taken by the hen.

The Secret of Educating Fleas.—The editor of *La Nature* has been investigating fleas, with a view of discovering where, in those insects, resides the capability of being educated. His conclusion is radical; he says they cannot be educated, and that all the tricks so ingeniously exhibited by self-styled trainers are merely caused by the natural efforts of the insect to escape. Any one can make them draw minute waggons or go through similar performances, if care be taken to secure them to their work so that they cannot jump. We learn, however, from the *Scientific American*, that a M. Bertoletto has visited New York and exhibited wonderful success as a trainer. The first lesson, he says, is to put the insects in a small circular glass box, where, by jumping and knocking their heads against the glass for a day or two, the

idea is finally beaten into them that it is useless to jump, and that during the remainder of their natural lives (to wit, about eight months), they must be content to crawl. Having subdued the jumping, the instructor fastens a delicate pair of wire nippers to the middle part of the flea's body, and to this a miniature vehicle, or other apparatus, may be attached. The fleas are allowed to feed twice a day on the instructor's arm.

A Plea for the Humming Bird.—*Land and Water* publishes the following extract from a letter from a lady residing in Westmoreland, Jamaica, in depreciation of the cruel practice of destroying the humming-bird for the purpose of decorating ladies' hats, as is at present the fashion :—"We have two magnificent ceifas, or silk-cotton trees, not far from the house, on which there must be many millions of dark crimson and maize-coloured blossoms, with a perfume very much like that of the Turk's-cap lily—rather too powerful for a bouquet, but when mingled with those of other trees by the breezes it is truly delicious. I see the humming-birds darting about the branches like sparks of emerald and crimson fire ; but, unfortunately, their number is being rapidly reduced by the womankind of England, who will decorate their silly heads with the lovely little bodies, which ought never to be seen except on the wing. Unfortunately, too, such is the course of fashion, the negro women here are adopting the same mode, and I fear there is not much doubt that the humming-bird will soon be exterminated. It is, indeed, a shame to destroy these little beauties in the ruthless manner they are being destroyed at the present time."

The Colours of the Chameleon.—The changes of colour in the chameleon have often excited curiosity. The phenomenon has lately been carefully investigated by M. Birt, who has discovered that the changes in question are due to coloured corpuscles, which change their position, now going down under the (yellow) dermis, now spreading in superficial ramifications and giving a green or dark tint. With maximum excitation, and also in complete repose (of sleep, anæsthesia, or death) the corpuscles are concealed. There is a special set of nerves for either of the two movements. The one set corresponds in many respects to the nerves which constrict the blood-vessels ; the other set (which bring the corpuscles to the surface), to those which dilate the vessels. Each cerebral hemisphere commands the colour nerves on both sides of the body, but it acts chiefly on the first-mentioned set of nerves on its own side, and the second set on the other side. Rays of the blue violet part of the spectrum act directly on the corpuscles, bringing them to the surface of the skin.

The Attacks of Harvest Bugs.—On a recent visit to the South Downs a member of the Entomological Society suffered much annoyance from the attacks of harvest bugs, as many as eighty pustules appearing on each foot. Mentioning this at a meeting of the society, several remedies were suggested, especially rubbing the affected parts with brandy and water ; but a Mr. Smith stated that on one occasion, when he was in the Isle of Wight and exposed to their attacks, he was effectually relieved from all annoyance by a dose of milk of sulphur.

Colours of Animals.—Despite the popular notion that the chameleon and other animals can change their colour at will, Professor Garman says there is a want of scientific evidence in favour of the belief. Drawing up for consideration a schedule of animals in two groups of comparative brilliance and paleness,

we find that light or darkness of habitat determines the colours as a whole. The amount of light in their surroundings is in inverse relation to the brilliance of colour. The dark colours are found in forests, and on dark soils; the light colours on plains and snow. The bleaching process applies to the lower surface, to the ventral portions of animals by reflection. In the water the same is true, the rivers with muddy bottoms being peopled by dark forms; the brilliant colours are found in hot and sunny waters or transparent lakes. This may be shown in a great variety of instances.

A Snake Story.—A curious snake story is told by the *New York Herald*. While out hunting, Mr. Richard Ives discovered a large cave in the side of a hill under a rock, and while opposite heard the squeaking of pigs inside. He stepped close to the mouth of the cave to investigate the matter, and, to his horror, saw protruding the head of an immense rattlesnake with a pig in its mouth. The pig was about four months old and weighed about 75 lbs. He summoned a number of his neighbours, with guns and pitchforks, who built a large fire in the mouth of the cave in order to drive the snakes out. In about an hour they commenced pouring out over the burning coals. As they approached in sight the parties fired upon them from the top of the cliff. They continued to pour out until the surrounding woods for twenty yards square was literally covered with dead and live snakes. They killed 310, but many made their escape. The largest one killed (a male) was ten feet long, and measured around the body one and a half feet; the next largest, a female, was seven feet long, and measured one foot around the body. The largest snakes were preserved in alcohol, and were to be exhibited publicly. The snake referred to had 110 rattles. The cave was literally filled with heads of sheep, pigs, &c., which had been captured from the surrounding country.

An Illustrious Visitor. — A young living gorilla was landed on the 23rd June, at Liverpool, by the German African Society's expedition, which arrived by the steamship *Loanda*, from the West Coast. The animal is a young male, in the most perfect health and condition, and measures nearly three feet in height. Only one other specimen has, it is stated, been brought alive to England.

The Ways of Ants.—Sir John Lubbock has made some curious experiments on ants, and found them not so intelligent as is commonly supposed. He placed a glass hive on a pole, and on the other side of the pole contrived a wooden promenade for the ants, with paper bridges from it placed at intervals, leading to three pieces of glass, on two of which there was no food, while the third contained a supply of food. Sir John Lubbock then taught two ants —artificially marked with a spot of colour, so as to be recognisable— their way to the food, guiding them over the right bridge. The creatures soon learnt their way, and were very diligent in fetching the food; but of the other ants, which had not been taught the way, very few reached the food, most of them going over the wrong bridges, and not apparently getting set right by the two initiated ants. Sir John believes that the ants do not hear any such vibrations as those to which the human ear is sensitive, but they turn away their antennæ from scented objects, and he ascribes such powers of guiding themselves as they have in great measure to smell. As regards family affection or regard for their species, he finds the ants deficient. When they find a dead ant, they usually pass by on the other side. A few appeared to feel con-

cern for a drowned fellow-creature, but he was obliged to regard this as an individual peculiarity.

Deep-sea Dredging.—Dr. W. B. Carpenter, at a meeting of the British Association, pointed out that, on the whole, the discoveries made in deep-sea bottoms had added few foraminifera to those with which we were already acquainted, but, at the same time, specimens had been found which added to that small group which, instead of covering themselves with shells, made to themselves sand casings. These were generally chambered, sometimes single, sometimes many in succession.

In New Caledonia. — New Caledonia has been written about by M. Germain, who considers that that country could easily support many useful animals which do not exist there. By their introduction the country would be greatly benefited, while its importance would also be increased by additional facilities being given for utilising its indigenous produce. It is peculiarly rich in timber, which affords shelter to many kinds of useful birds.

Animal Life in Japan.—The August number of the *Bulletin de la Société d'Acclimatation de Paris* contains a very instructive paper, by Dr. Vidal, on the fauna and flora of Japan. The useful indigenous animals of that country are not so numerous as the geographical position of the islands would seem to indicate; the principal are a small species of ox, goats, rabbits, and wild boars. Imported animals, such as sheep and pigs, are rare, the former, indeed, not appearing to thrive in the climate, although they exist in considerable quantities on the opposite coasts of Northern China. A species of small black bear, and monkeys, are prized by the natives as articles of diet. Horses are abundant, though the ass and the mule are unknown in the country. Birds, both useful and ornamental, are very numerous, the principal being several varieties of duck and common "barn-door fowls," pheasants, and quails; wild geese are abundant, but the domestic variety and the turkey are almost unknown. Of fish there is a plentiful supply, and the fisheries form one of the most important industries of the country. Salmon are very common and highly prized.—*Nature.*

Showers of Worms. — The *Morgenblad* of Christiania states that a singular phenomenon was observed there after a recent violent storm. A number of worms were found crawling on the snow, and it was impossible to find the places from which they had issued, everything being frozen in the vicinity. Similar circumstances were reported from several places of Norway.

What is Coral?—The composition of coral has been carefully investigated by Professor Dana. Ordinary corals have a hardness a little above that of common limestone or marble, giving out a ringing sound when struck with a hammer. This may be owing, he considers, to the carbonate of lime being in the state of aragonite. It is a common mistake to suppose that coral, when first taken from its watery bed, is soft, and hardens through exposure. The live coral may feel somewhat slimy in the fingers, but if the animal matter be washed away it is found quite hard. Chemically, the chief constituent of all is carbonate of lime, in the proportion of 95 to 98 parts in 100, with 1½ to 4 parts of organic matter, and some earthy ingredients, such as phosphate of lime with a trace of silica, amounting usually to less than 1 per cent. Forchhammer found 2·1 per cent. of magnesia in *Corallium rubrum*, and 6·36 in *Isis hippuris.* The source of these constituents are the sea water and the ordinary food of the polyps, the process of absorption,

assimilation, and secretion going on in them as in all animal organisations.

A Victim of a Panic.—Mr. Frank Buckland writes in *Land and Water* :—"A few days since I was informed by letter that a wild animal was ranging the country at and about Hurstbourne-park and Whitchurch, Hampshire. My correspondent urged me to get Mr. Jamrach, the animal dealer, to send down his men to catch this mysterious wanderer. Eventually, I hear, quite a panic arose in the neighbourhood, and every sort of story was circulated of the ravages and dangers the country was exposed to. The people began to think that, besides their sheep and pigs, their children were in danger. Some people said it was a gigantic black fox, others that it was a Canadian wolf. Then expeditions were organised to attack him, and the master of the hounds (Colonel Nichols) was invited to hunt him with his pack, but he wisely declined. Ultimately this mysterious wild beast was chased for some miles by people on horseback, and shot at Wonston. They then carried the animal to Winchester, and exhibited him at 6*d.* a head in the market place, as testimony of the prowess of the hero who had shot it. On Saturday morning I received a letter from my friend Captain Allen Young, of the Arctic ship *Pandora.* He tells me that the black wolf, or, the gigantic fox, is simply his poor tame favourite Esquimaux dog, which he brought over in the *Pandora* from the Waigat Settlement, North Greenland. He was a 'king dog,' and leader of a sledge team, and a most valuable and harmless animal. With five others of his breed he would do a journey of from 50 to 60 miles over the ice on the Greenland coasts with a loaded sledge, and without a rest, and would then, during the night, protect his master from the freezing blasts of the wind by surrounding him in his sleep, and would be ever ready to raise the alarm of a passing bear or the coming storm. Up to the time—a month ago—when he was either stolen or wandered from the *Pandora,* he was the pet of the ship, and would always greet his master or any member of the crew with his paw whenever they approached him. There can be no mistake that Captain Allen Young's pet Esquimaux dog has met with a sad fate, as the captain has got back his skin."

The Dublin Lioness.—In the report of the council of the Dublin Zoological Gardens, the following account of the death of one of the lionesses is given :—

"During the course of the year the gardens sustained a heavy loss in the death of the beautiful lioness, familiarly called 'Old Girl' by her friends and admirers. She was born in the gardens, of South African stock, on September 8th, 1859, and died on October 7th, 1875, after six weeks' prostration from chronic bronchitis. During her long and honoured career, she presented the gardens with fifty-four cubs, of which she actually reared fifty, losing only four. This is a feat unprecedented in the history of menageries and gardens. She was a lioness of very high spirit, although very gentle, and was admitted by judges to be the handsomest lioness they had ever seen. It may be added that her offspring not only added to the attractions of the gardens, but that the judicious sale of a portion of them brought £1,400 in cash for the benefit of the society. The closing weeks of her useful life were marked by a touching incident worthy of being recorded. The large cats, or carnivores, when in health, have no objection to the presence of rats in their cages ; on the contrary, they rather welcome them, as a relief to the monotony of existence, which constitutes the chief trial of a wild animal in confinement. Thus it is a

common sight to see half-a-dozen rats gnawing the bones off which the lions have dined, while the satisfied carnivores look on contentedly, giving the poor rats an occasional wink with their sleepy eyes. In illness the case is different, for the ungrateful rats begin to nibble the toes of the lord of the forest before his death, and add considerably to his discomfort. To save our lioness from this annoyance, we placed in her cage a fine little rattan terrier, who was at first received with a sulky growl; but when the first rat appeared, and the lioness saw the little terrier toss him into the air, catching him with professional skill across the loins with a snap as he came down, she began to understand what the terrier was there for. She coaxed him to her side, folded her paw around him, and each night the little terrier slept at the breast of the lioness, enfolded with her paws, and watching that his natural enemies did not disturb the rest of his mistress. The rats had a bad time during those six weeks."

Live Animals by Post.—The arrangements of the Post-Office are in some respects inimical to private enterprise, and it was but the other day that a person residing at some distance from Dantzig, having been requested by the proprietor of a menagerie in that town to forward two hares to his address, found himself confronted by a postal regulation forbidding the transmission of live animals by post. It then occurred to him to chloroform the hares, carefully calculating the dose, in order that they might remain in an insensible condition until delivered. But the train was late, the parcels were verified, and laid aside in the sorting room to be sent out next morning. Accordingly, a sorter entered the room at dawn, went through the letters and parcels, and missed "108, two hares." He looked for them high and low, but in vain. Their disappearance seemed inexplicable; the lock of the door was intact, the window barred, and the whole staff unanimously declared that the parcel of game was there the night before. As the bewildered sorter again looked round the apartment, one of the hares shot by him, followed by the other, on the back of which the post office stamp at D—— was plainly visible; both darted out at the open door. This was too much for the nerves of the sorter, who almost fell to the ground in astonishment, and the thought of the spectral hares would long have embittered his lonely hours had not the proprietor of the menagerie called to inquire after the expected consignment, and explained the circumstances. It is needless to add that "108" and his companion have not been seen since their hurried exit from the Dantzig Post-Office.—*Pall Mall Gazette.*

Innocent Sparrows and Guilty Beetles.—A correspondent of "Hardwicke's Science Gossip" says that in his garden in the West of England he was much troubled with sparrows—as he and his gardener imagined—which came in flocks and nipped off his peas as soon as ever they had fairly shot above ground. He tried all sorts of expedients for keeping off the birds, but was surprised to find that the better he succeeded in doing this the faster his peas disappeared. This led him to investigate the matter a little more attentively, and he soon noticed that the young leaves were notched in a manner not at all likely to be the work of a bird's bill. Ultimately he discovered his real foes in the shape of small beetles, *Sitonia Lineata*—striped pea weevil—to which he believed the whole of the mischief was attributable. The reputation of these impudent and pertinacious birds for destructiveness in this particular line is so well established that it might have been supposed they had come for the peas of

which they were fond, and found an animal diet they liked better still. This does not appear to have been the case, however, for though the attention of the sparrows was afterwards encouraged, and measures taken which soon resulted in the total rout of the real enemy, the peas were never afterwards injured. The writer says he has seen whole fields of peas destroyed by this insect. Lime, soot, or finely-powdered road dust, or all of them mixed together, dusted over the crops in early morning, while the dew lies upon them, he finds spoils the appetite of these pests, and if it does not absolutely destroy them, does what some people would perhaps prefer that it should do—drives them away to neighbours' crops.

Revengeful Bees.—Writing to the *Times*, "M." says:—"A most extraordinary event has occurred at Abingdon. A donkey, tethered a short distance from two hives of Ligurian bees, was attacked and killed by them. This is the second year that these bees have become aggressive after their harvest of honey has been taken from them. The owner of these hives is a bee-fancier, and the honey is made in boxes, which latter are removed when filled. In this way the bees are deprived of their natural food, and at a time of year when there is little or no honey to be got from flowers. The country around Abingdon is, moreover, at all times very unsuited to bees. The consequence that the poor things are now wholly dependent on artificial feeding, and when this is not sufficient or is neglected, they of course become exasperated with starvation. Last year these same bees invaded private houses, and even formed marauding companies into the town of Abingdon (nearly half-a-mile distant from their hives), and made an inroad on the sugar in a grocer's shop. They not only wreaked vengeance on the unfortunate donkey, but attacked passers-by in a road at the back of their hives, and also two ponies going along the road. Perhaps Ligurians are remarkably savage by nature, but, at any rate, this event may make others besides myself question whether it is altogether advisable to deprive bees in this way of their honey. The old-fashioned plan of destroying the bees to take the honey has been much deprecated of late, but I question if it is not more humane than to let the poor little industrious creatures suffer from hunger when they have worked hard all the summer for their winter store. This is a fact overlooked perhaps by many who are interested in bee-keeping."

Hatching Ostrich Eggs.—The following is a description of the incubators generally used for the hatching of ostrich eggs, taken from a handbook of the Cape Colony recently published by Mr. John Noble, Clerk of the Cape House of Assembly:—

"The incubator consists of a wooden box, about three feet square, open from above, and capable of containing twenty-five eggs. It rests upon a copper or zinc pan or cistern, three inches deep, and equal to the size of the box. This is filled with hot water, and has four or five openings through which the vapour ascends into the box. The warm temperature of the water is maintained by a paraffin lamp kept burning underneath the pan; but in some cases this has been found objectionable, as the fumes of the lamp affect the young chicks as they leave the egg, and it is an improvement to have the lamp burning in an adjoining compartment, an extension of the cistern or pan about a foot wide being carried through the partition or wall, and the lamp placed under it. The heat can be regulated as necessary, thermometers being constantly in use. The temperature of

the box where the eggs are placed is 102 degs. Fahr. when they are first put in; after two weeks it is gradually reduced to 100 degs., and in two weeks more to 98 degs. The period of incubation is forty-two days. The eggs are turned and aired by opening the box and blanket covering once or twice a day. A fortnight before the expiration of the time, they are held up against the light to examine their condition, and a week after are slightly, but carefully, punctured near the top with a sharp-pointed steel, to enable any of the chicks in weak condition the more readily to break the shell. When hatched, they are turned, kept warm, and fed with cut lucerne, and allowed to run about their inclosures like ordinary fowls."

In natural hatching the average number of birds raised is sixteen out of twenty eggs; in artificial, when properly managed, not more than one out of twelve eggs fails.

Pisciculture.—Nine-tenths of our supply of fish are lost by neglect and want of enterprise. Of all countries in Europe we ought to make everything piscatorial our study, for not only is it a question of food, but indirectly the solution of, perhaps, the more important problem of supplying our Naval Reserve. The more our fisheries are developed, and the larger the number of hands employed in fishery occupations, the greater our Reserve in case of need. A man whose life is passed in boats or along shore, no matter how small the craft he may be employed in, is worth many landsmen when we need sailors, so that in cultivating our shore fisheries we enlarge materially the national resources in time of war.

The mussel as an article of food is well worthy of cultivation, and the title of "poor man's oyster" is not at all a bad one, as mussels are largely consumed by those to whom the oyster is an unattainable luxury. Both mussels and winkles chiefly come to us from long distances, as from Scotland and Ireland, while our native produce is so far neglected that it is worthless in the market for want of culture.

Almost all descriptions of sea fish may be cultivated in ponds or tanks with facility and profit; and, provided the enclosures be reasonably large, reproduction also goes on as freely as in the open sea, with the immense advantage of the young fry being sheltered and protected from their enemies. Experiments have proved that in one year a plaice will acquire a weight of 2lbs.; and soles, turbot, and other ground feeders grow and thrive equally well without care or attention. For one fully-grown fish taken by trawlers, there are at least ten others worthless from their small size, and if these were deposited in tanks on the shore they would, when fully-grown, yield a very handsome return to their proprietors.

There is another advantage in the use of fish reservoirs, and that is, there will no longer be a necessity to pack fish in ice for transport, unless, indeed, for long distances. Ice rapidly destroys the fine flavour of turbot, and indeed of all fish, and I am assured by one of the largest West-end dealers that fish forwarded fresh and not ice-packed, would command a very high price.

Our national limits are so small, that fresh fish could be dispatched from any part of our coasts on receipt of a telegram, and arrive in their finest condition. Beef and mutton are sent up in their best condition, but at present good, bad, and indifferent fish are thrown at once on the market, and at one time there is a scarcity and on the next day a glut in the market. In such cases every one is a loser, for the purchaser in a time of scarcity pays extravagant prices for his food, and the next day the purveyor cannot

obtain a fair return for his outlay. Depôts round the coast will prevent all this, and put an end to the wanton and wasteful destruction of valuable food. At Concarneau, well known for its sardines, at Kermoor, and at La Teiche, in France, all descriptions of fish are carefully preserved in tanks, with very satisfactory pecuniary results; and Paris is at present largely supplied from such depôts.

We cannot in this country expect the constant care and watchful attention of our Coastguard to be given to such matters as the surveillance of our fishing population, nor do we expect the Government to provide us with model fisheries, as in France, for their instruction; but whatever foreigners do, we can ourselves see and adopt if good, and in these and many similar matters we have much to learn. There is in France a special branch of the Marine Department to look after the foreshores of France; but, except in disputing the local rights of some lord of the manor on questions of salvage, we do not see the influence of our Board of Trade brought to bear.

As said before, all descriptions of salt-water fish thrive well in tanks, provided they are of reasonable size; and, as the fecundity of fish is immense, the enterprise of developing the undersized and of fish-farming generally is not a visionary scheme, but one worthy the attention of our *savans* and of all who value the prosperity of our fishermen, and who, having found recently the hollowness of foreign investments, seek at home for some enterprise yielding a certain and fair return for their capital. To such—and they are many—the cultivation of the shores of our bays, creeks, and rivers offers a sure investment, for "the harvest of the sea" is more certain than that of the land, and the yield immeasurably greater.—G. W. H. in the *Times*.

A Nest-building Fish.—In ponds and trenches near the Ganges, a pretty little fish is found called the *rainbow fish*; it is characterised by its brilliant colours, and by the presence of a long filament substituted for the ventral fins. Some curious facts have lately been given by M. Carbonnier as to the nest-building habits of this animal. Seizing a little conferva plant with his mouth, he raises it to the surface. Left there, the plant would sink, but the little fish obtains some air bubbles and places them at intervals under it as a support. Repeating the process several times, he thus produces, the first day, a small floating island. Next day he continues the supply of air, and accumulates the bubbles towards the central part, the effect being to produce a sort of vegetable dome, balanced on the surface. He then makes a rim for it, with the same materials, plants, and bubbles; and, going inside, he smooths and softens the interior surface. The female is then solicited to enter. After laying her eggs the female withdraws, leaving to the male fish the education of his family. He deposits the eggs with care, separately, in the raised part of the nest. At a later period, when he sees they need a different medium and treatment, he rises in the middle of the dome and bursts it, letting the bubbles escape; whereupon the structure flattens in the water, with the imprisoned embryos, which are beginning to appear in a new stage of existence. To prevent their escape he tears the flat rim of the nest into a sort of hanging fringe. For some time he exercises great surveillance over the progeny, till their frequent escapes and excursions announce the end of his fatigues, which occurs some eight or ten days after flattening of the nest.

Ants, Bees, and Wasps.—Sir John Lubbock read the following

paper on ants, bees, and wasps, on the 4th November, 1875, before the Linnean Society. It formed a continuation of previous papers on the same subject. (*See* p. 25.) In them, he said, I recorded various experiments tending to show that, in many cases, ants and bees which have found a store of food or of larvæ certainly do not communicate the information to their friends. This unexpected observation was received with so much surprise, and, indeed, was so unexpected to myself, that I determined to repeat the experiments, which I have now done, with, however, the same result. To take one as an illustration. I placed an *F. flava* (the small red ant) to a heap of larvæ, which, as is well known, are fleshy, legless grubs, incapable of motion. I placed them about two feet from the entrance to her nest. I then watched her from eleven in the morning till after seven in the evening, during which time she made 86 journeys from the nest to the heap of larvæ, carrying one off each time; but although she had so much work to do, and though the precious larvæ were lying for so long exposed to so many dangers and to the weather, she brought no other ant to assist her in carrying them off. One of the ants, I observed, in this way carried off, one by one, no less than 187 larvæ in a day. In other instances, on the contrary, the opposite result occurred.

I was for some time uncertain, in the latter cases, whether the ants purposely brought friends to their assistance, or whether, as the ants are sociable insects, it merely happened that the one accompanied the other, as it were, by accident. To test this question, I took two ants, and placed them under similar circumstances, the one to a heap of larvæ, the other to a group of two or three; always, however, putting one in place of any that was carried off, and it was quite clear that the ants which were placed to the large group of larvæ brought far more friends to their assistance than those which had apparently only two or three larvæ to move. Of thirty ants which were observed, those placed to a large number of larvæ brought 250 friends, while those placed to two or three larvæ, under similar circumstances, only brought 80.

One account, much relied on as showing the intelligence of ants, has been the following observations made by Mr. Lund, in Brazil. Passing one day under a tree which stood almost by itself, he was surprised to hear the leaves falling like rain. On examining the cause of this, he found that a number of ants had climbed the tree, and were cutting off the leaves, which were then carried away by companions waiting for them below. Of course it might be said that the leaves which dropped fell by accident; in which case they would naturally be carried off by the ants below.

It occurred to me, however, that this was an observation which might easily be repeated. I placed, therefore, a number of larvæ on a slip of glass, which I suspended by a tape, so that it hung one-third of an inch from the surface of one of my artificial nests; isolating it, however, in such a manner that for an ant to walk to the nest she would be obliged to go thirteen feet round. I then placed some black ants (*F. nigra*) on the glass with the larvæ. Each of them took a larva in the usual way, and then endeavoured to go by the quickest way home. They leaned over the glass, and made every effort to reach down, but of course in vain, though the distance was so small that they could all but touch the nest with their attennæ, and even, in one or two cases, succeeded in getting down by stepping on the back of an ant below. however, who did not meet with any

such assistance, gradually, though at first requiring some help from me, found their way round to the nest, and after a short time there was quite a string of ants passing to and fro from the nest to the larvæ, although it would have been so easy for them to throw the larvæ over the edge of the glass, or to go straight home, if they would have faced a drop of, say, one-tenth of an inch. Moreover, I placed some fine mould within half an inch of the glass, so that it would have been easy for the ants, by literally one minute's labour, to have constructed for themselves a stepping-stone up to the glass, yet they did not adopt any of these expedients, but for hours together, and by hundreds, continued to make the long journey round. I confess this experiment, which I repeated on several occasions, surprised me very much.

As my previous experiments, which showed that bees did not by any means in all cases bring their friends to share stores of food which they had discovered, have been much questioned by bee-keepers, I have repeated them again. No doubt if honey is put in an exposed place, so that it is found by one bee, it is most natural that others should also find their way to it; but this does not, according to my experience, happen if the honey is concealed. For instance, I put a bee to some honey in a flower-pot placed on its side, and so arranged that the bee had only a small orifice through which to enter. Under these circumstances, from a quarter to seven in the morning to a quarter past seven in the evening, she made 59 journeys, and during the whole of this time only one other bee found her way to the honey.

I found that bees soon accustomed themselves to look for honey on papers of particular colours. For instance, on September 13, I placed a bee to some honey on a slip of glass on green paper, and after she had made twelve journeys to and from the hive, I put red paper where the green had been, and placed another drop of honey on a green paper, at a distance of about a foot. The bee returned, however, to the honey on the green paper. I then gently moved the green paper, with the bee on it, back to the old place. When the bee had gone, I replaced the green paper by a yellow one, and put the green again a foot off. After the usual interval, she returned again to the green. I repeated the same proceeding, but with orange paper instead of green. Again I tried her with blue; she again came to the green. I then reversed the positions of the blue and green papers, but still she returned to the green. I repeated this experiment with other bees, and with the same result, though it seemed to me that in some cases they did not distinguish so clearly between green and other colours. In other respects they seemed to adhere equally closely to any colour to which they were made accustomed.

As regards wasps, my experiments fully confirmed those previously made, and justified everything which I have said with reference to their great industry. Indeed, they begin to work earlier in the morning and cease later in the evening than bees, continuing with the utmost assiduity. Thus, a wasp which I watched on the 10th of September worked from seven in the morning until seven in the evening, without a moment's intermission, during which time she made no less than 94 visits to the honey.

As is the case with bees, if a wasp is put to exposed honey, others soon come. To determine this, if possible, I trained a wasp to come to some honey which I placed in a box communicating with the outside

of an india-rubber tube six inches in length, and one-third of an inch in diameter. She came to this honey continuously for three days, during which time no other wasp found the honey.

As regards colour, I satisfied myself, by experiments like those made with bees, that they are capable of seeing colour, though they appear to be less influenced by it than are bees.

Game in France.—"We are threatened," writes a newspaper correspondent, "with the complete disappearance of every species of game, and even of small birds, in various parts of France. In some of the Departments any kind of animal that can be shot at is so scarce, that when a hare or a woodcock appears in a district, a number of sportsmen rush out upon it at once, and the unfortunate animal falls from the simultaneous discharge of a line of fowling-pieces. It is to prevent the total extermination of a number of useful and harmless creatures that the Minister of the Interior has addressed to the Prefects a circular in which he recommends them to watch closely the enforcement of the game laws. The Society for the Protection of Animals is bringing its influence to bear on the Government with the view of causing the adoption of a regulation with the same object. They propose that the owners of dogs should be compelled to put a collar, bearing their name and address, on the necks of their pets, so that they might be rendered responsible for any damage done amongst the game. This practice has been followed in Lisbon for some time, but considerable difficulty has arisen from a breach of the law which has accompanied it; for, as all the police can insist on is that a collar with an inscription should be worn by every dog, the authorities have been put to no end of inconvenience by the discovery that whenever a defaulting puppy was taken into custody he invariably carried a wrong address."

III.—THE WORLD OF PLANTS.

Under the Shade of Camphor Trees.—The tree which supplies the camphor of commerce coming from Japan is the *Laurus camphoratus*, in Japanese *Jennoki.* It is widely distributed, but flourishes best in the southern parts of the country, especially in the province Toso in the island of Sikok. The mild damp air of the sea-coast is favourable to it. The production of camphor is carried on the whole year round, but best in winter. The workmen erect a temporary hut in some neighbourhood where there are camphor trees. After hewing down a tree they cut it into small regular chips, which are taken in baskets to an oven, placed generally on a slope where there is a flow of water. Here the material is distilled. The camphor carried off in vapour and deposited is afterwards gently pressed, thus yielding about 25 per cent. of clear oil. This at present serves no other purpose than that of a lighting material for poor people ; notwithstanding a strong smell and much smoke, they burn it in open lamps. Completely purified camphor is not exported from Japan ; the Japanese product undergoes further distillation in Europe. The camphor chips, or shavings, after drying, are used as fuel.

The Forests of Europe.—Of all the countries of Europe, Russia, it appears, has the largest surface covered with forests — viz., 193,544,400 hectares (not including Finland and Caucasus). Next come Sweden and Norway, with about 25 millions of hectares, and the German Empire with over 14 millions. France has about 7½ million hectares, of which 991,766 belong to the State, 1,903,258 to communes or public establishments, and a little less than 5 millions to private individuals. These statistics are given in a little work recently pnblished in Paris by MM. Dupont and Bouquet de la Grye, "Les Bois Indigènes et Etrangers."

Good Digestion. — According to observations of M. Heckel, published in the *Comptes Rendus*, the glands of the flowers of Parnassia have a digestive property like that of the leaves of Drosera.

Timber Preserved.—To preserve timber for mines, Herr O. Koug packs the timber, cut in proper lengths, in a vertical position in an iron reservoir, provided with a tight-fitting cover. The vessel is then filled to about three-fourths of its capacity with a solution of the carbolate of soda. Into this he leads steam, which speedily brings the liquid to the boiling point. The access of the steam is continued until, by its gradual condensation, it has filled the vessel to its full capacity. The wood is allowed to remain in the hot liquid some hours ; this is then drawn off, and the wood is washed with a dry steam jet.

A Rock on Fire.—While recently engaged in botanical exploration on the higher parts of the island of Réunion, M. de l'Isle heard of some caverns the soil of which was combustible. He visited one of them and found it a grotto about 10 metres in depth and 6 metres broad. Entering by a small aperture you descend to the bottom by a rapid slope. The bottom is formed, more than an inch thick, of a substance of ochre-yellow colour, soft to the touch, insipid, inodorous, dividing

readily into very light fragments, which leaves yellow powder on the fingers; they are easily reduced to powder by pressure or friction. When a lit match is brought to one of the fragments the latter burns, if dry, with a very short yellow flame, like German tinder, with abundant smoke, and a smell of burnt herbs. MM. Bureau and Poisson have studied this interesting substance with the microscope, and found it entirely composed of small bodies which must be spores or grains of pollen. After various comparisons they were struck with their resemblance to spores of *Polypodeæ*, in form, and reticulation, and colour; and they found among the *Polypodeæ* of Réunion, sent home by M. de l'Isle, one whose spores are almost identical with the small bodies in question. From the cohesion of the spores, and the slit found in most of them, by which the contents have escaped, it is inferred that this accumulation has been caused by water, and not by wind. In any case it is probably the first time that a rock has been found of such composition.—*Journal of Science.*

Huge Trees of California.—In the park of M. Siffait, in the Lower Loire, a *Wellingtonia gigantea*, planted in 1855, is now more than 72 feet high, and about a yard from the ground has a girth of 7 feet. In the same locality a plant of *Bambusa mitis* threw up a stem of more than 22 feet, in two months, while a *Yucca albospica* produced an inflorescence 8 feet high. The rapid growth of these imported plants is truly surprising.

Vegetable Stupidity.—There is so much said about "vegetable instinct," "vegetable sagacity," and "vegetable volition," that I propose to direct attention to a fact that is as familiar to every observer as the sun and moon and seven planets. In my corn-loft there is now a grand growth of ivy, the result of the intrusion of stout long rods from the wall outside. For a plant to thrust its arms into a place destitute of the light, air, and moisture requisite to its well-doing cannot be called "sagacious." Any one who thrusts an arm in where it is sure to be cut off must be wanting in instinct, or at all events in intelligent volition. As the tendency just now is to claim for vegetables something like infallibility, it may be seasonable to make a note of a case of vegetable stupidity.—S. H., in the *Gardener's Magazine.*

Germination in a hurry.—A remarkable example of rapid germination has been lately recorded in the *Gartenflora*, which is very interesting on account of the nature and natural habitat of the plant in question. Most gardeners have either heard of or read of, if not seen, the singular Rose of Jericho, *Anastatica hierochuntica*. The plant belongs to the *Cruciferæ*, and is a dwarf radiately branched annual, inhabiting the sandy wastes of North Africa and Syria. When the individual plant has fulfilled its mission—that is to say, produced flowers—and when the seed is in course of ripening, the leaves decay and fall off, and the branches curve inwards, forming a ball of the entire plant. After this it soon becomes detached from the soil, and is blown hither and thither with the moving sands. During this time the seed-vessels remain closed, but the first rain causes the branches to unfold and the seed-pods to open. Now it is obvious that the most favourable conditions for the continued reproduction of an annual plant on the shifting sands of the desert must be quick germination and growth, and a kind of locomotion. The strange prickly, almost or quite leafless, shrubs and undershrubs characteristic of the desert flora retain their vitality for years, alternately buried beneath the sand

and exposed to the influences of the sun and air; but an annual plant would probably soon become extinct under the same conditions. According to a writer in the periodical quoted, seeds of *Anastatica hierochuntica*, sowed about 5 o'clock in the afternoon, had germinated by 1 o'clock the following day, and their rootlets had already pierced the soil. These seeds were taken from a plant purchased at the Vienna Exhibition, and twelve out of fifteen germinated in the time mentioned, in a pot covered over with a saucer, and standing in an ordinary living-room. This, like the germination of the seeds of the mangroves on the trees, seems to be a special provision for the perpetuation of the species.—*Gardeners' Chronicle.*

Venus's Fly-trap.—The structure and movements of the leaves of *Dionaea muscipula.* (Venus's fly-trap) have lately been examined by M. de Canoville. An interesting paper on the subject was contributed by him to the *Archives des Sciences*, 15 April. The following is his résumé of the principal points established. 1. The absorption of matter of animal origin is not utilised directly by the leaves, and it is not necessary to the development of *dionaea.* 2. The marginal appendages form, with the edge of the limb, a member distinct from the rest of the leaf, which explains why their movement does not take place simultaneously with that of the valves. 3. The star-like groups of hairs and the gland result from development of the epithelium only, while the subepidermic parenchyma concurs in development of the excitable hairs. 4. There are stomata on the two sides of the wings of the petiole, while the valves have them only on their under surface. 5. The anatomical structure and the development of the different parts of the leaf favour the hypothesis, according to which the movements of these two valves result from variations of turgescence of the parenchyma of their upper surface considered as alone active. 6. The excitable hairs are exciting organs, which allow of the shocks they undergo acting directly on the subepidermic parenchyma.

Medicine for Vines. — Iron pyrites is now successfully employed as a remedy for the oïdium of vines. It is preferred to sulphur.

Foreign Friends. — Several Australian plants, including among others the great Australian tree-fern and others similar, as well as acacias and gum trees, have been introduced into Arran, in the Frith of Clyde. The climate apparently suits them well. The "blue gum" grew 11½ inches the first year, 4 feet the second, and 6 feet the third. The *Eucalyptus pendulosa* seems also to flourish in sheltered situations along the west coast.

Cordage from Broom.—In the southern parts of Italy—Calabria and the Basilicata more especially—and in Tuscany, a variety of genista, *Spartium junceum*, or Spanish broom, is much used for cordage, coarse baggings, &c. Not only is it cheaper than flax or hemp, but lighter and stronger as well. In some parts of France it is used for the same purpose. Another variety, *Spartium scoparium*, or common broom, grows plentifully in Italy, and furnishes an abundance of fibre, but there appears to be a prejudice in favour of the Spanish broom.

News for Tanners.—A tannin plant, common in the Missouri valley, seems likely to become a substitute for bark. The *Polygonum amphibium* yields about half as much tannin again as bark, and the leather produced from it is said to be in every way superior, while the process is exactly the same. The *Polygonum* is an annual, but can be gathered exactly like hay.

Palm Trees in New Granada.

—Bruchmüller narrates that in his passage up the Magdalena River, New Granada, he noticed a tall palm (*Sheelia regia*) so entirely surrounded by a growth of a species of fig-tree (*Ficus dendroidea*) that the top only was visible. This species of palm, under the names of Palma roal and Palma dé vino, occurs frequently lower down the river, and the natives obtain from it a covering for their huts, and prepare a kind of wine similar to champagne from the sap and a most excellent salad from the heart, while other portions afford strong fibres.

How to choose Timber.—In selecting timber the principal points to be observed are adaptability and straightness of fibre (if the timber is to be used to resist any pressure or strain), freedom from shakes and knots, and thorough dryness. Slow-growing timber shows narrow annual rings, and should be preferred. The cellular tissue should be compact and hard. Under the saw the wood should not appear woolly or be clammy in feeling. A fresh-cut surface should be clean and bright, not dull. Of resinous woods those with the least resin are the strongest and most durable; of other sorts the least sappy are best. White and bluish streaks or patches or dark-coloured stains indicate sap.

Protecting Vines from Frost.—The production of artificial clouds of smoke is a common appliance against frost in France and Germany. Monsieur Vinard has recommended a plan which is perfectly successful, and which consists in carefully mixing gas-tar with sawdust and old straw, and piling up this mixture in large heaps in the vineyards. The mixture remains inflammable more than a fortnight, in spite of rain and weather. When required for use, smaller heaps are made from the larger ones, about 2 feet in diameter, and distributed in and around the vineyard. If there is little wind these heaps burn freely for about three and a half hours, and produce a very dense smoke. The artificial cloud which thus enwraps the vines considerably decreases the radiation from the ground, and therefore prevents frost, which is greatest toward morning during calm spring nights.

Carnivorous Plants.—In corroboration of the view that organic substances are actually digested and assimilated by the leaves of certain plants, an important series of experiments has been performed by Mr. J. W. Clarke. He obtained large quantities of plants of *Drosera rotundifolia* and *intermedia*, and a smaller quantity of *Pinguicula lusitanica*, and fed the leaves with the bodies of freshly-killed flies soaked in citrate of lithium. The needful precaution being taken to prevent the solution being carried mechanically to other parts of the plant, after an interval of forty-five or fifty hours, various portions of the plant were then incinerated, and tested spectroscopically for lithium. The result was to prove conclusively that the products of digestion, after absorption by the leaves, do enter the leaf-stalk, and are thence distributed to other parts of the plant.

Indian-rubber Plantations.—The introduction into India of the true Para Indian-rubber tree (*Hevea*) is now fairly inaugurated. In the beginning of August, 1876, 2500 healthy plants were dispatched by barge from Kew for embarkation. The plants now dispatched are part of those obtained in the Kew hot-houses, from seed brought direct (with great care) from the Tapajos. The *Hevea* is the India-rubber tree of Brazil, which yields the best caoutchouc.

Some plants of *Castilloa elastica* or the caoutchouc tree of Central America, have been sent to Ceylon. The plantations of chincona on the

Neilgherry hills are very successful, nearly 3,000,000 plants being now flourishing luxuriantly, besides many others in private plantations. Nearly 30,000 lbs. of bark were shipped to London from the government plantations in 1875.

The Breath of Plants.—The flowering of certain plants being accompanied by an elevation of temperature and disengagement of carbonic acid, has led to the inference that at this stage they respire in the same way as animals. The sugar stored up in the plants undergoes the alcoholic fermentation, and the alcohol so formed is burnt, thus producing the heat needful for reproduction. A ripe apple or pear placed in lime-water will render it turbid by the evolution of carbonic acid. The fruit, after being thus protected from the air, will yield a notable quantity of alcohol, as shown by Messrs. Lechartier and Bellamy, in their researches on the ripening of fruits.

Reproduction in the Mushroom Tribe.—At a meeting of the Woolhope Club, Mr. W. G. Smith read a paper "On Reproduction in the Mushroom Tribe." It was altogether a remarkable one. He concludes from his microscopic observations that, so far from infusorial animals being spontaneously generated, they are only differentiated forms of already living cells. He finds that boiling does not destroy the cause of life. He boiled infusoria, and hermetically sealed the tube. After a month, a drop of water from this tube was examined under the microscope, and all appeared dead — certainly all was motionless. In a few minutes appeared signs of life, and an hour after, infusoria were found in the active enjoyment of existence.

Hair, Soap, and Stuffing for Chairs.—A bulbous plant called the soap plant, long known to the Indians and the old Spaniards, is now claiming the attention of Californian settlers generally. This plant grows all over the country, and sometimes in very large quantities, and is now attracting much attention, with a view to its cultivation. The bulb is enclosed in a fibrous coating. It is found that, when dressed, these fibres run into four or five different qualities; the finest is like human hair, and being naturally of the fashionable colour, it is in great request for ladies' use, the other qualities for various purposes. The coarsest of the fibres are used for stuffing sofas, chairs, and other articles of furniture, and also for stuffing railway carriages, superseding crimped horse-hair, being equally elastic, and much sweeter. It is expected that more than a thousand tons will be exported during the present summer, and it is now thought desirable to bring the plant into general cultivation. The core of the bulb makes a first-rate lather with water, equal to the finest soap, and its properties for cleansing are very great.

A Health-giving Tree.—It appears from the report of Père Gildas, that the *Eucalyptus globulus* possesses in itself a principle which has been found an excellent remedy against the toxic effects of the miasmata of the marshes in the unhealthy districts round Rome, where it has been recently planted. Several cures have been effected by means of a decoction of the leaves of the trees. The leaves are also prepared as a powder, which is equally potent, and has the merit of keeping longer.

Hard-working Roots.—A remarkable instance of the penetrative power of roots, under certain conditions, was recently observed by M. Meunier. A block of quartzose sandstone — which is harder than marble — had been pierced by roots of elms of various thickness; the roots were long

dead and almost decomposed, yet portions of them remained in the tubes they had made.

A Chinese Plant.—The Jardin des Plantes at Paris has recently received a Chinese plant which has not hitherto been seen in Europe. It changes colour three times during the day, and naturalists have in consequence termed it *Hubiscus mutabilis.*

A Huge Fungus.—An account of the very rapid growth of a fungus observed by M. Hoffmann in July, 1875, comes to us from Griessen, in Germany. The mushroom was a specimen of *Bovista gigantea,* one of the largest of the indigenous species. At the commencement of the observations it was about the size of a small child's head, and from beginning to end of the time, it was pretty spherical. Its girth on 16th July was 30cm., and on the 22nd of the same month it was 62cm. During the time of observation there was rain daily.

Tomatoes in Favour. — M. Siroy, writing in the *Journal of the Central Horticultural Society of France,* says that he has found the leaves of the tomato to afford efficient protection against the attacks of the aphides. Tomato-leaves are macerated in water, and this water sprinkled over rose-trees or other plants attacked by aphides, speedily causes the insects to disappear. This is a new use of the tomato, which on other grounds has been fast coming into public favour. A dry and rather poor soil best suits the plant, as luxuriance is thus best checked and fruitfulness promoted. As soon as the plant is well loaded with fruit, manure and water may be largely supplied, and the fruit should be cut off as it ripens, or rather a little before it is quite ripe, as the growth of that portion of the fruit not yet arrived at maturity is assisted thereby.

A Vegetable Phœnix.—A singular phenomenon is recorded in the German journal, *Der Naturforscher,* as having happened in an orchard near the village of Bruchelheim. A large fire occurred in the village in the beginning of September, and four weeks after it numerous trees in the orchard that had been singed by the fire began to vegetate anew, putting forth tender green leaves and blossoms, often by the side of fruits which the fire had spared. On examining the wood with a microscope, it was found that the contents of the cells were transformed into a pulpy mass. Sugar was found to be present both in the singed and unsinged trees.—*Globe.*

Plants in the Dark.—According to Deherain, leaves kept in a confined atmosphere in darkness will absorb the whole of the oxygen, and still continue to give off carbonic acid, the resistance to asphyxia varying with the species. The rapidity of growth and energy of respiration of plants are both favoured by obscure heat; and it is shown that the internal combustion, by the absorption of oxygen and emission of carbonic acid, is the origin of part of the heat necessary to the elaboration of new proximate principles in the plant.

The Motions of the Fly-trap.—Professor Burdon-Sanderson gave an account, at a meeting of the British Association, of his researches "On the Electrical Phenomena exhibited by *Dionæa muscipula* (the Fly-trap)." He had accurately investigated the phenomena by means of the electrometer. He found that normally the whole leaf with the petiole was somewhat negative, but that, when excited by a stimulus, an electrical change took place throughout, making every part more negative; the greatest change was on the external surface of the leaf immediately opposite to the three sensitive hairs. There was no relation between the pre-existing currents and

the electrical disturbance consequent on stimulation. The period of latent stimulation was about one-sixth of a second; the period during which the disturbance lasted was one second, more or less. As the leaf becomes fatigued, the period of latency gradually increases to one second and three-quarters, and then most likely the next stimulation would produce no effect. The change appears to be a function of the protoplasm of the parenchyma of the region out of which the sensitive hairs arise. Certain of the characters of the change are similar to those presented by muscle and nerve. Why the variation should be a negative one, Prof. Sanderson had no idea.

The Lowest Forms of Plant Life.—The formation of cheese has lately engaged the attention of Prof. Ferd. Cohn, in connection with his researches on the lowest forms of plant life; and he has made personal observations on the manufacture as carried on in Switzerland. The phenomena accompanying the process are thus described:—The rennet contains a liquid ferment which causes coagulation of the milk; also ferment-organisms (*Bacillus*), which probably bring on butyric-acid fermentation, and cause the slow maturing of the cheese. It is their resting-spores that, enclosed by the dry cheese substance, resist boiling heat for a long time, and, in a suitable nutritive liquid, may afterwards develop to bacillus rods.

A Shower of Sulphur.—*Galignani* reports that during the wet weather in the early part of 1876, the curious phenomenon known as a shower of sulphur was observed in some parts of the Hérault. After the rain the leaves of the trees and the sides of the road were covered with a yellowish powder resembling sulphur. This curious occurrence happens rarely in the South of France, but is very easily explained. The yellow matter which causes the appearance is only the pollen of conifers carried off by the wind from some pine-forests.

Singular Property of Tomato Leaves.—"I planted a peach orchard," writes M. Siroy, of the Society of Horticulture, Valparaiso, "and the trees grew well and strongly. They had but just commenced to bud when they were invaded by the curculio (*pulgon*), which insects were followed, as frequently happens, by ants. Having cut some tomatoes, the idea occurred to me that, by placing some of the leaves around the trunks and branches of the peach trees, I might preserve them from the rays of the sun, which were very powerful. My surprise was great upon the following day, to find the trees entirely free from their enemies, not one remaining, except here and there where a curled leaf prevented the tomato from exercising its influence. These leaves I carefully unrolled, placing upon them fresh ones from the tomato vine, with the result of banishing the last insect and enabling the trees to grow with luxuriance. Wishing to carry still further my experiment, I steeped in water some fresh leaves of the tomato, and sprinkled with this infusion other plants, roses, and oranges. In two days these were also free from the innumerable insects which covered them, and I felt sure that, had I used the same means with my melon patch, I should have met with the same result. I therefore deem it a duty I owe to the Society of Horticulture to make known this singular and useful property of the tomato leaves, which I discovered by the merest accident."

Encouragement of Planting.—The law in New York State making provision for planting shade trees along the highway is as follows:—"Any inhabitant liable to highway-tax who shall transplant by the side of the public highway

any forest shade trees or fruit trees of suitable size shall be allowed by the overseers of highways, in abatement of his highway tax, $1 for every four trees set out; but no row of elms shall be placed nearer than 70ft., no row of maples or other forest trees nearer than 50ft., except locust, which may be set 30ft. apart; fruit trees must also be set at least 50ft. apart, and no allowance as before mentioned shall be made unless such trees shall have been set out the year previous to the demand for said abatement of tax, and are living and well protected from animals at the time of such demand.

Taking Impressions of Plants.—M. Bertot, of the Paris Academy, has just made known a simple method of taking impressions of plants, requiring only a large sheet of paper, some olive (or other) oil, blacklead, ashes, and resin (or colophony). The paper is first lightly oiled on one side, then folded in four so that the oil may filter through the pores, and the plant may not come into direct contact with the liquid. The plant is placed between the leaves of the second folding, and in this position pressed all over (through other paper) with the hand, so as to make a small quantity of oil adhere to its surface. It is then taken out and placed carefully on white paper; another sheet is placed above (since two impressions can be taken), and the plant is pressed as before. On now removing it an invisible image remains on the paper. Sprinkle over this a quantity of black-lead (or ashes, &c.), and distribute it in all directions, as in applying sand to writing; the image will then appear in all its parts. With an assortment of colours the natural colours of plants may be reproduced. To obtain fixity, resin is added to the black-lead (previously) in equal quantity; the impression is fixed when it is exposed to a heat sufficient to melt the resin.

Plants under the Influence of Ether.—The eminent physiologist, M. Claude Bernard, has lately made a number of experiments which prove that etherisation acts on plants as well as on animals. All vital acts, whether in the animal or in the plant, may be anæsthetised. Thus, in plants, germination is arrested by the influence of ether. The author proves this in the case of cress introduced into a tube with ether. The germination was stopped. On removing the ether, however, it began again. It was not a case of death, but only anæsthesia. The same with other plants, and even with ferments, whether of plants or of animals. Thus beer yeast, in contact with ether for twenty-four hours, is thrown into sleep, from which, however, it awakes when the etherisation ceases. M. Bert, in his experiments on the influence of oxygen on living things, killed the yeast. M. Bert observes that, as regards a sensitive object, we should distinguish its provocable movements and its spontaneous movements. Under the influence of etherisation it is only the former that are arrested, the others still go on.

A Large Leaf.—M. Von Hulle, of the Botanical Gardens, Ghent, says the *Gardeners' Magazine*, found that a large leaf of the Victoria Regia could sustain a weight of 760 lbs. avoirdupois—say, five men of average size, In the pantomime played at Drury-lane Theatre in the beginning of 1876, the fact was turned to account for the production of a fine effect in a scene in which fairies stood on lily-leaves, and the swaying of the leaves by the movements of the water was admirably imitated.

Half Pine, Half Fir.—A singular tree is now growing in a wood near Eureka, California. The tree is half pine, half fir. Its height is about 75 feet, and for a distance of

30 feet above ground it is pine, the next 20 feet are fir, and the remainder to the summit is pine. The fir portion of the tree is in flourishing condition, and the foliage perfectly dense, but in the pine portion the leaves are scarce.

Serviceable Rushes.—In an article on Rushes, a contributor to the *Gardeners' Chronicle* points out that the plant has rendered considerable service to commerce. The canals or water-ways constructed by the Duke of Bridgewater owed much of their stability to the rushes planted all along their banks, and particularly on the towing-path side, where the fringe of rushes saved the rope from fretting; in short, the plant seemed essential to the canal, for its toughly-mattéd roots bound the banks firmly, and formed the crowning sod, making an elegant fringe, as useful as if it were made of hewn stone. Unlike the working of any shrub or tree that would outgrow its place in a year or two, the rush retains its evergreen wisps to all appearance for ever; and we see Brindley's rushes little more than a foot high after a generation of boatmen have brushed their tops ten times a day.

Cut Flowers in Vases.—A correspondent of the *Gardeners' Magazine* says:—"It is a common experience that flowers in vases soon perish, and the subject appears to me worthy of a note in the interest of those of your readers who find it difficult to keep their table and mantelpiece flowers in good condition. For my every-day enjoyment I keep filled a large trumpet-shaped green vase, and a pair of beleek vases on the mantel. I used to change the water, and I used also to put lumps of charcoal in it, and yet my flowers soon fell to pieces; but of late years I have found it sufficient to replenish once a-week all the winter, and twice a-week all the summer, and my flowers keep well. On occasions when I have left home I have found them still bearable, if not brilliant, after from fifteen to twenty days; but in hot summer weather they would not, of course, last so long. If they last, as a rule, a week, I think it sufficient, for, after all, freshness is everything in respect of flowers. Thus much by way of preface to a practical remark to this effect, that the secret of keeping flowers in good condition is not to disturb them in any way after they are once put up. To give fresh water, to cut off the stalks, and so forth, is really waste of time; for although they will look a little better if carefully touched up and rearranged, they soon after fall to pieces. As to the use of charcoal, it is quite superfluous. If the water sinks too low, as it will in summer, carefully pour some in by opening the flowers gently with the hand. In keeping cut flowers, therefore, the less that is done to them the better."

Growing Grapes.—As a successful example of amateur grape-growing, we give an instance of a vinery attached to a farmer's residence. The house is span-roofed, 27 ft. in length, and 16 ft. in width. The roof area is 486 ft. This roof has lately carried 400 bunches of grapes, principally Black Hamburgs, varying in weight from ¾ lb. to 2½ lb. each. The berries were fine and well coloured. Of these grapes the owner sold, beyond what he required for his own use, upwards of 200 lbs. and realised more than sufficient to pay his fuel bill, and other expenses of management. The soil he used was sound turfy loam and bones, and to this was added heavy top-dressings of manure and copious supplies of water.—*Journal of Horticulture.*

A New Cereal.—A new cereal has been grown in the State of Oregon, and thus far no one has been able to classify it, for though it

bears a general resemblance to wheat, yet its stalk, mode of growth, and heavy filaments cause it be taken for rye or barley by the most experienced farmers. The grain was originally discovered in the stomach of a wild goose by a farmer. From seven to ten stalks spring from one root, and attain a height, when ripe, of four and a half to five feet. They are very thin, compact, of a bright straw colour, and extremely heavy. —*Scientific American.*

Odd Powers in Plants.—The small cup-shaped petals, which form the nectaries of *Helleborus*, are gifted with the same power of absorbing and digesting nitrogenous substances as the leaves of the Venus' fly-trap, and the Sundew. This has been shown by experiments instituted by Dr. Masters.

Orchards, Woods, and Market Gardens.—In a Parliamentary return just issued, the following details are given relating to the quantity of land cultivated as orchards, market gardens, nurseries, and woods in Great Britain. The grand total in acres is as follows:—Orchards, 154,584; market gardens, 38,957; nursery grounds, 12,042; woods and coppices, 2,187,078. The counties in England whose acreage in orchards exceeds 20,000 acres are Devonshire, Herefordshire, and Somersetshire; those whose acreage is over 10,000 are Gloucester, Kent, and Worcester. The acreage for market gardens is largest in Middlesex—viz., 5,221 acres. Essex comes next, with 4,110; then Kent, 4,028. All the other counties are far behind, those adjacent to the large towns, such as Manchester and Liverpool, having naturally the largest acreage. The acreage per county occupied as nursery ground for growing trees, shrubs, &c., varies from 10 acres in Rutlandshire and 12 in Bedfordshire to 1,334 in Surrey, this latter county having by so much the largest acreage that even Kent —the next on the list—has only 618 acres. Middlesex has 592 acres. While the total acreage in England of orchards is 150,600, and in Wales, 2,535, in Scotland it is only 1,449—an eloquent exposition of the influence of climate. There are 35,364 acres of market gardens in England against 712 in Wales, and 2,881 in Scotland.

The Soap Weed.—A substitute for soap has been found in New Mexico—the soap weed, the roots of which are used for washing by the Mexicans. They consider the plant superior to ordinary soap for cleansing woollen goods, as it extracts all dirt and grease, and restores the lustre of the material.

Bark for Paper Making.—The inner bark of the baobab-tree is found to furnish an excellent fibre for the manufacture of paper, and, unlike other trees, the baobab does not appear to be injured by the removal of the bark, which soon grows again, and, it is reckoned, may be removed every eight years. The bark after being beaten is dried in the sun and done up in bundles for exportation. The bark of young trees produces the best paper.

The Eucalyptus Globulus.—The Italian Government, persuaded by the success of the Trappist brotherhood of San Paolo fuori le mura di Roma, that the *Eucalyptus globulus*, of which we have made mention in a preceding paragraph, has a beneficial influence in malarious districts, has presented to the landholders of Italy large supplies of slips of the tree for the purpose of forming plantations where its virtues seem required. The Government also intends to grow the *Eucalyptus* along the boulevards of the large cities, and even along the various lines of railway throughout the kingdom. Landholders themselves, remarks the *Lancet*, are following the initiative of the Government, and in a few years Italy expects to drive malaria as effectively from its

borders as ague has been expelled from those of Lincolnshire.

Flowers for Food.—It is not often that we find the flowers of a tree or plant used as an article of food. Such instances, of course, says the *Gardeners' Chronicle*, are not wanting; the capers of our "caper sauce" are well known to be flower-buds of *Capperis spinosa*, or of *Zygophyllum fabogo*, which latter are occasionally substituted for real capers. In many parts of India, however, Dr. Brandis tells us, the flowers of a Sapotaceous tree, *Bassia latifolia*, form a really important article of food. These blossoms, which are succulent and very numerous, fall by night in large quantities from the tree, and are gathered up early in the morning; they have a sweet but sickly taste and smell. They are then dried in the sun and sold in the bazaars. An ardent spirit, which is strong and intoxicating, is distilled from these flowers by the hill people, who also eat them either raw or cooked, often with parched grain; they are also put in sweetmeats. The blossoms of another species, *B. longifolia*, are employed in a similar manner by the natives of Mysore and Malabar, where it abounds; they are either dried and roasted, and then eaten, or bruised and boiled to a jelly and made into small balls, which are sold or exchanged for fish, rice, and various sorts of small grain. The flowers of both species are also eaten by owls, squirrels, lizards, jackals, &c.; and Roxburgh mentions a report that the last-named animals "are apt to grow mad by too much feeding on them," especially in the time of blossom.

Manna.—Although the manna of commerce is, as is well known a saccharine exudation from the stem of the Manna Ash (*Flaxinus ornus*), we learn from the *Pharmacographia* that it was formerly obtained from the leaves of that tree. Previous to the fifteenth century the manna used in Europe was imported from the East, and was not that of the stem. "Raffaele Maffei, called also Volaterranus, a writer who flourished in the second half of the fifteenth century, states that manna began to be gathered in Calabria in his time, but that it was inferior to the oriental." At this period the manna collected was that which exuded spontaneously from the leaves of the tree, and was termed manna di foglia or manna di fronda; that which flowed from the stem was called manna di corpo, and was less esteemed. The manna di foglia became quite unknown, so much so that a writer in 1770 questioned its existence. This was owing to the introduction, about the middle of the sixteenth century, of the plan of making incisions in the trunk and branches of the tree—a plan which was at first opposed by legal enactments, but which, nevertheless, became generally adopted on account of the more copious supplies which the collectors were thereby enabled to obtain.

The "Tea Tree."—The beautiful coral-like fruit with which the so-called tea tree (*Lycium barbarum*) has been loaded in some localities this autumn (1875), has suggested the inquiry whether it has ever been turned to any useful purpose. So far as we know, no experiments have been made in this direction, but it is at least probable that it would be worth while to institute a few judicious investigations into the matter, especially as we learn from Dr. Brandis that the fruit of allied species is eaten in India. The berries of *L. europæum* are eaten in the plain districts of the Punjab, Sindh, and Guzerat; and camels and goats feed on the branches.—*Gardeners' Chronicle.*

The Growth of Plants.—The direction of plant-growth, it is known, is determined both by light and by gravity. The geotropism, or action

of gravity exclusive of light, has before been examined; and recently M. Müller (Thurgau), we learn from *Flora*, has endeavoured to study the converse fact of heliotropism, by excluding the influence of gravity as far as possible. He grew his plants in a cylinder rotating about its horizontal axis. The apparatus was so arranged that the light, coming through an aperture in the shutter of a dark room, fell parallel to the axis; the bendings observed were thus purely heliotropical. Among other results he found that only those zones which were not fully grown out showed heliotropic bendings; that the most strongly-growing parts of the stem were most sensitive to one-sided illumination; that the bending takes some (variable) time to manifest itself, and continues some time after removal of the cause; that the rate of bending is at first slow, gradually increases to a maximum, and thereafter diminishes; that the bending is greater the intenser the light, &c.

Flowers for Perfuming Tea.—According to a recent Chinese *Materia Medica*, the principal flowers used in perfuming tea are those of *Gardenia radicans*, *Jasminum sambac*, *Aglaia odorata*, *Ternströmia japonica*, *Camellia sasanqua* and *Olea fragans*, those of the last-named shrub being especially esteemed for the purpose. The leaves of *Silax alba*, and many other species of willow, are employed in making a kind of tea called T'ien-cha, and are openly mixed at Shanghai with the tea intended for exportation.

The Sorrowful Tree.—In the island of Goa, near Bombay, there is a singular vegetable, "the sorrowful tree," so called because it flourishes only at night. At sunset no flowers are to be seen, and yet half an hour afterwards it is full of them. They yield a sweet smell, but the sun no sooner begins to shine than some of them fall, and others close up. This continues throughout the year.

Black Roses.—A Californian has succeeded, after several experiments, in raising roses as black as ink. His plan was to engraft a slip of a dark red rose into an oak-tree, where it grew, flourished, and blossomed, the dark sap of the oak effectually colouring the rose black.

Harmony of Colours in Flowers.—One of the obscure points of science is the cause of the harmony of colours always observed in flowers. An exchange states that when two colours are found, they are generally complements of each other. The wild asters of autumn generally have purple rays and yellow disc flowers. The pansy is yellow and purple, and the blue violet has its stamens yellow and its petals a reddish blue. In fact yellow and purple generally go together in flowers. A splendid example is afforded by the large *Iris Germanica*, the popular fleur-de-luce of our gardens. From the white base of its petals the colourless sap passes into its petals, which become of a gorgeous purple, while the beard of the petals becomes at the tip a very rich yellow, though the lower part of each separate filament is not of the purest white. What chemical or physical law determines the arrangement of colour, if there be any such secondary cause, is not yet discovered. Two French chemists, Fremy and Cloez, say that the tints of flowers are due to cyanin, xanthin, and xanthein. Cyanin is reddened by acids. A supply of vegetable acid developed in a flower would then turn the blue to rose colour, while a scarcely sensible quantity might produce a purple. Xanthin is a yellow from the sunflower, and xanthein the yellow of the dahlia.—*English Mechanic.*

Climates for the Eucalyptus.—M. de Saporta has recently communicated to the Central Horticul-

tural Society of France a note on the minimum temperature which can be borne by *Eucalyptus globulus* and other plants in the South of France. M. de Saporta remarks that, during the winter of 1870, the temperature at Hyères, sank to 8° C. below freezing point, when the lemon was killed to within three feet of the ground, the orange half-way down, while the *Eucalyptus globulus* only suffered in some of its smaller branches. *Buonapartea sp.*, *Dracæna indivisa*, *Chamærops excelsa*, *Sabal umbraculifera*, and *Cocos australis* remained unhurt; and *Corypha australis* was much injured, but subsequently recovered. The date palm suffered but little, though the oleander was killed to the ground, All the plants just mentioned were planted in the open, and received no protection. *Chamærops excelsa*, in the Basses Alpes, withstood a cold of 16° C. below freezing point, with only a little litter around the stem. *Eucalyptus globulus* does well in slightly moist or even in dry soils, but not in those which are constantly moist; while *Sabal Adansonii*, which also resisted 8° C. below freezing point, does well in marshy places.

Market Gardening near Paris.—M. Herzé, Inspector-General, and member of the Committee of Agriculture, has contributed the following statistics respecting the market gardening near Paris, in a paper read before that society:—"At the present time the market-gardens in the suburbs of Paris are 1800 in number, covering an area of 1378 hectares (3404 acres). Those within the walls of Paris occupy 750 hectares (1852½ acres). The average size of these gardens is from 1½ acres to 1¾ acres. They generally contain a dwelling-house as well as a stable, and a shed. The land lets at from 1000 to 1200 francs per hectare (16*l.* 3*s.* 4*d.* to 19*l.* 7*s.* 6*d.* per acre) and the house at from 300 francs to 400 francs (12*l.* to 16*l.*). The land is never at rest, and produces from two to three crops yearly. For such a cultivation a great deal of labour is necessary, abundant manure, and frequent watering, and often artificial shelter has to be provided for the crops, so that in these 1800 gardens there are 360,000 forcing frames and 2,160,000 bell glasses. The owners rise at two o'clock in the morning in summer, at four o'clock in the winter; the master is always at the head of his men, while the wife looks after the women, and it is she alone who attends to market. The population employed in market gardening is about 7500 persons, the value of the stock is estimated at 8 millions of francs (320,000*l.*) 1,200,000 francs (48,000*l.*) is spent annually in stable manure, whilst the value of the vegetables sold amounts to 12 millions of francs (48,000*l.*), and 300,000 francs (12,000*l.*) is obtained from the sale of exhausted soil."—*Journal of the Society of Arts.*

Coffee in Danger.—A good deal of attention has been directed of late to the island of Dominica as a coffee-producing country. At one time coffee was one of the staple productions of the island, and was grown not only in large quantities, but also of excellent quality. At the present time little or none is exported to Europe, but the island still grows sufficient to supply its own demands, and we believe sends a little to the neighbouring islands. This falling off in the coffee-plant, in a soil and climate which experience showed was eminently suited to it in every respect, was due to the extensive destruction of the plants by what was then known as the coffee blight. This was soon found to be of insect origin, but no active or energetic measures were taken to rid the island of the pest, which continued its ravages, destroying many plantations, and even

driving planters away in great numbers.—*Nature.*

Coffee-Growing in India.—The cultivation of coffee in India is steadily progressing, and although the introduction of the plant into the eastern portions of the country is of ancient date, it is only within the last twenty years that much attention has been given to its production. The principal plantations are situated in Mysore and the Neilgherry Hills, at an elevation of 3000 to 4000 feet above the level of the sea. The climate of these districts, besides being well adapted to the cultivation of the coffee-plant, is not so injurious to Europeans as many other parts of the country, and it is probable that the industry will be largely developed.—*Nature.*

Spring Flowers.—The average day of flowering of thirty-two spring flowers has been determined, of which the following are examples:—*Galanthus nivalis*, Jan. 25; *Eranthis hyemalis*, Jan. 30; *Hepatica triloba*, Jan. 31; *Corylus Avellana*, Feb. 2; *Rhododendron atrovirens*, Feb. 3; *Crocus susianus*, Feb. 4; *Leucojum vernum*, Feb. 10; *Daphne Mezereum*, Feb. 22; *Narcissus pumilus*, March 10; *Orobus vernus*, March 11; *Muscari botryoides*, March 18; *Ribes sanguineum*, March 22; *Narcissus pseudo-Narcissus*, March 31; and *Fritillaria imperialis*, April 1.—*Nature.*

Eucalyptus Globulus out of Favour.—Sometime ago the Army Sanitary Commission forwarded a memorandum to the Government of India regarding the alleged benefits which were expected to follow the cultivation of the *Eucalyptus globulus* in malarious districts. The reports that have reached this country from India are such as finally to dispose of the question. It appears that the Government of India have been importing seeds of the tree for many years past at a considerable expense, but that the only places where it has been cultivated with success, are Raneckhet, in the South-west Provinces, and the Neilgherries, in the Madras Presidency. All attempts to rear it in the plains, where its alleged anti-miasmatic qualities would be most appreciated, have proved failures. Mr. O'Connor observes: "It is a native of the cool, temperate zone of the Australian continent and Tasmania, and its unsuitability to the tropical plains of this country seem now manifest." After enumerating the virtues currently attributed to the tree, he adds: "The catalogue of the virtues of the blue gum-tree makes me think of the wonderful powers supposed 300 years ago to be possessed by that 'most holy herb,' tobacco." Clearly such statements want confirmation before they can be accepted. They bear, indeed, on their face the mark of exaggeration. In one of the papers in which an account of the properties of the tree is given, it is stated that the British Government has largely grown it in India and on the West Coast of Africa with astonishing results in the diminution of fever. Now, we know that in India no such results have been obtained, and on the West Coast of Africa attempts are only now being made to introduce the tree. Mr. Broughton, the government quinologist, says that he has examined the bark and leaves of the *Eucalyptus globulus*, and that neither quinine, quinidine, chinchonidine, nor chinchonine, is contained in the plant in any proportion.—*Lancet.*

Flax from New Zealand.—Among the smaller plants of New Zealand, the *Phormium tenax*, or New Zealand Flax, is of especial value. In the preparation of this fibre the province of Marlborough has been from the first introduction of the industry, one of the principal exporting districts. At the present time there are about eight mills with from two to six machines

in each. Many men are also employed in cutting and carting the raw materials to the mills, for which they are usually paid by the load. The operations of stripping, washing, and bleaching are carried on by men and boys, who receive wages varying from 10*s.* to 15*s.* a week for boys, and from 20*s.* to 25*s.* a week for men, board and lodging being also found. The scutching of the fibre and packing it into bales for export are generally undertaken by contract, the ordinary price given being at the rate of 30*s.* per ton. Whenever practicable, water-power is employed to drive the machinery necessary for the extraction and preparation of the fibre, and this has, of course, a considerable advantage over steam-power, in the saving of the fuel and labour required for the latter. The state of the flax trade at present cannot be considered as satisfactory, owing to circumstances affecting the English market; but there can be no doubt that a little time will remove the difficulties retarding its development, and that it will ultimately prove one of the largest and most remunerative articles of export. In abundance and quality of the raw material, and facilities for producing the manufactured product at a paying price, no other province is believed to possess so many advantages.—*Journal of the Society of Arts.*

Hemp from Japan. — Japan produces hemp of the finest quality, and probably, when machinery has been brought to bear on the industry, it will compete favourably with Manilla hemp. The plant is perennial, and attains a height of six feet and upwards; the stem is covered with a short hairy substance; the leaves are heart-shaped, with a sharp point, their surface being of a bluish colour, and the back white; both sides are furry and rough to the touch. In the summer small sprouts of about two or three inches in height appear at the point where the leaves join the stem, and throw out blossoms, which develop into small white flowers. Mr. Consul Robinson gives the following account of the manner in which the fibre is obtained:—When the summer has set in, the plantation is fired, after which the ground is well prepared with manure, and left till the close of summer, when the shoots will have attained their full height. They are then cut and soaked in running water for about four hours. After immersion the stalks are broken in about three places, by which means the rind is separated from the pith. In the interstice thus made the thumb of the left hand is inserted, and the stalks shredded. The shredded parts are placed in layers, and are next laid on a board which has a foot-piece at one end, so as to make an inclined plane. A small edged tool is then grasped in the right hand, the shreds being firmly held down with the left, and the inner white coating is scraped off. The shreds are now hung upon a frame, after which they are again placed on the board, and this time the outer green pith is scraped off. The fibre is then tied together in bundles and dried. This dried fibre is woven into cloth, and all kinds of piece goods. The outer green bark or peel is also dried, macerated, and made into pulp, being used for the manufacture of the coarsest kind of papers. It is sometimes used in its dried state by the poorer classes as a stuffing for mattresses. The best of the outer or surface fibre is also made up into a material very strong in texture, and of a mouse colour. The pith, or what is left after obtaining the fibre, is utilised in finishing off the thatch of houses.

Monkey Fruit Trees.—The Baobab, or Monkey Fruit Tree, is well known from descriptions as one of the giants of the vegetable world.

It rears its vast trunk 30 or 40 feet high, with a diameter of three or four feet in the baby plants to usually 20 to 30 in the older trees. Monkey Fruit Trees have been measured of as great a size as over 100 feet in circumference: "the thickest trunk," says one writer, "I have ever seen was 66 feet in circumference, and was clean and unbroken, without a crack on its smooth bark." The leaves and flowers are produced during the rainy season, and are succeeded by the long, pendant, gourd-like fruit, like hanging notes of admiration. Millions of these trees cover the whole of Angola, as they do, in fact, the whole of tropical Africa, sufficient to supply an incalculable amount of paper material for years.

Wild Rosemary Wanted.—The wild rosemary (*Ledum palustre*) has been suggested as a substitute for Persian insect powder. When dried as well as fresh it is destructive to lice, bugs, fleas, moths, &c. The tincture prepared from it is also a remedy for the bites of gnats, and insects generally, not only relieving the itching in a short time but also the pain, when applied to a wound. The tincture repels gnats, when mixed with glycerine and rubbed upon the skin. It seems to deserve notice on account of these properties, and its possible substitution for the more expensive and frequently adulterated Persian insect powder. It is most effective when fresh and in bloom, and should be gathered in the latter condition.

Mind in Plants.—As Dr. Forbes Winslow has remarked, vegetable life is so universally assumed to be, as a matter of course, unconscious, that it appears to many a mere folly to express a doubt of the correctness of the assumption. But, he continues, let a close observer and admirer of flowers watch carefully their proceedings on the assumption that they not only feel but enjoy life, and he will be struck with the immense array of facts which may be adduced in support of it. Endow them hypothetically with consciousness, and they appear in a new and altogether different aspect. His conclusion is that they are undoubtedly in the same category in this respect with the lower forms of animal life, respecting which it is impossible to determine whether they have consciousness or not.

Dr. Lander Lindsay goes further, and regards mind and all its essential or concomitant phenomena as common in various senses to plants, the lower animals, and man; and he backs his belief with a cogent array of evidence, which, while it fails to demonstrate absolutely his position, shows very clearly the drift of scientific opinion.

Dr. Asa Gray, after speaking of the transmission of the excitability of sensitive plants from one part of the plant to another, the renewal of excitability by repose, and the power which the organs of plants have to surmount obstacles to positions favourable to the proper exercise of their functions, goes on to say that, when we consider in this connection the still more striking cases of spontaneous motion which the lower algæ exhibit, and that all these motions are arrested by narcotic or other poisons — the narcotic and acid poisons producing effects upon vegetables respectively analogous to their effects upon the animal economy—we cannot avoid attributing to plants a vitality and a power of making movements toward a determinate end, not differing in nature, perhaps, from those of the lower animals. Probably, he adds with characteristic cautiousness, life is essentially the same in the two kingdoms; and to vegetable life faculties are superadded in the lower animals, some of which are here and there indistinctly foreshadowed in plants.

Darwin has observed in the *Iro-*

sera rotundifolia a faculty for selecting its food, which in animals would certainly be attributed to volition. Mrs. Treat has described the same trait in the plant. On being deceived by means of a piece of chalk, the drosera curved its stalk glands towards it, but, immediately discovering its mistake, withdrew them. The plant would bend towards a fly held within its reach, enfold it, and suck its juices; but would disregard the bait if out of reach, showing not only purposive movement (or a refusal to move, as the case might warrant), but also a certain power of estimating distance.

Again, Darwin has shown that the more perfect tendril bearers among climbing plants bend toward or from the light, or disregard it, as may be most advantageous. Also, that the tendrils of various climbers frequently attached themselves to objects presented to them experimentally, but soon withdrew on finding the support unsuitable. He says of the *bignonia capreolata* that its tendrils "soon recoiled, with what I can only call disgust," from a glass tube or a zinc plate, and straightened themselves. Of another bignonia, he says that the terminal part of the tendril exhibits an odd habit, which in an animal would be called an instinct, for it continually searches for any little dark hole in which to insert itself. The same tendril would frequently withdraw from one hole and insert its point in another. In like manner, spirally twining plants seem to search for proper supports, rejecting those not suitable.

Speaking of phenomena of this sort, Dr. Lindsay makes this strong remark: "In carnivorous and climbing plants, there is a choice or alternative between action or inaction, acceptance or refusal; and the choice made is not always judicious. There may be an error, and the error may be corrected; but in order to such correction, there must surely be some kind of consciousness or perception that a mistake has been committed; an exercise of will in making further efforts at success, and a knowledge of means to an end, with their proper adaptation or application."

According to Professor Laycock, organic memory is common to both animals and plants, and certain *lianas* seem to exhibit it in a marked degree in their antipathy to certain trees. The botanist Brown has remarked that the trees which the *lianas* refuse to coil round are physically incapable of supporting the climbers.

And not only do many plants act, as one might say, reasonably, but some exhibit the opposite quality. In his "Vegetable Physiology," Professor Lawson speaks of the eccentric movements of the side leaflets of *hedysarum gyrans*, which make it appear as though the whole plant were actuated by a feeling of caprice.

In many cases observers are, no doubt, self-deceived, and mistake a mechanical and wholly unconscious mimicry of intelligent action for an actual exhibition of intelligence; still such men as Dr. Gray and Mr. Darwin are not apt to be deluded by mimicry or figures of speech; and however much it may run counter to popular notions of what is proper to plant life, the hypothesis that intelligence does not end with animal life seems by no means inconsistent with a multitude of trustworthy observations. — *Scientific American.*

A Most Useful Tree.—A tree, which would be a valuable acquisition to any country where it would condescend to grow, is specially mentioned by Consul Morgan in his supplementary report on the trade and commerce of Brazil for the year 1874. The tree in question is the carnouba (*Copernicia cerifera*), a palm

tree, which, without any culture, re-develops itself in Ceara, Rio Grande do Norte, Bahia, &c. Perhaps in no country, says Consul Morgan, is a plant applied to so many and varied purposes. It resists the most prolonged drought and preserves itself constantly luxuriant and green. Its roots possess the same medicinal effects as the sarsaparilla. From the trunk are obtained strong fibres, which acquire a beautiful lustre, as well as corner pieces of timber and excellent palisades for enclosures. The palmetto top when young serves as an appreciable and nutritious food; and therefrom also wine, vinegar, and a saccharine matter is extracted, as well as a kind of gum similar in its taste and properties to sago. This plant has often served during the period of excessive droughts as the means of support to the populations of Ceara and Rio Grande do Norte. From the wood and trunk of the tree musical instruments are made, as also tubes and pumps for water. The delicate fibrous substances of the pith of the stalk and its leaves make a good substitute for cork. The pulp of the fruit is of a pleasant taste, and the nut, oily and emulsive, is, after being roasted and reduced to a powder, often used as coffee. From the trunk of the tree a species of flour similar to maizena is extracted, as well as a liquid resembling that of the Bahia cocoa-nut. From it, dried straw, mats, hats, baskets, and brooms are made; and of this straw large quantities are exported to Europe, where it is employed in the manufacture of fine hats, the whole value of which exportation, and of such as is utilised by national industry, amounting now to about 117,500*l.* per annum. Finally, from its leaves is produced the wax used in the manufacture of candles, the annual exportation of which exceeds in value 162,500*l.*

Improvements on Nature.—If we may rely upon the curious statements occasionally made respecting the possibility of artificially altering the colours of flowers, and which have been put together in the form of an interesting article by an American paper, the art of manipulating flowers may be expected to be rather extensively developed. Red roses, dahlias, pansies, and several other flowers, it is said, almost instantaneously become white if held over the fumes of sulphurous acid. The effect of dipping many blossoms into a little ether to which a tenth part of ammonia has been added, is said, on the authority of M. Filbot, to be very remarkable. Red, pink, or violet flowers become intensely green. Scarlet geraniums, red roses, heliotropes, and lilacs become after immersion a vivid copperas green. Some other flowers, differing from these in colour, assume various shades of dark blue. White flowers sometimes become orange, though generally yellow. The rose geranium is said to become blue in a very curious manner. The valerian becomes grey, red cockscombs dark violet, and other flowers of various kinds assume a beautiful brown metallic appearance. Yellow flowers are not affected. These changes may be effected during the period of growth, and flowers may be sprinkled, or otherwise marked, without wholly immersing them. A violet-coloured flower, for instance, may be spotted or striped with white while still growing in the ground. M. Gabba has brought about changes of a similar kind by ammonia alone. He merely poured the fluid in a plate, inverted over it a cone, open top and bottom, placed the flowers over the top of it, and found that very astonishing changes were produced merely by the volatile ammonia. He adds, too, that asters, which have no odour, under the influence of ammonia acquire a very agreeable smell.

The Eucalyptus in France.

—In the department of Var, in the South of France, M. Cortambert planted three years ago 2,000 seedlings, a few inches high, of the *Eucalyptus globulus*. The trees have now attained an average height of 30 feet, with a girth of about 14 inches at 3 feet from the ground. It has been found necessary of course to thin the plantation, as the whole 2,000 were planted in a space of one hectare. The wood of the Eucalyptus is extensively used in Algeria for carriage-building, and plantations are becoming numerous in the South of France.

The Cultivation of Tea.—A series of interesting articles has lately appeared in the *Planters' Gazette* on Indian tea. From one of these we take the following extract:—

There are two modes of cultivating tea—very high and low cultivation. The former consists in not sparing expenditure, and thus urging the plant in every way to yield largely. The second plan is to work cheaply, under the idea that though the produce will be smaller the profits will be larger. Both these systems have had their advocates, and have been fairly tested during the last ten years. The results are all in favour of the first plan, and the advocates of the second are now very few. Such as still believe in it have probably had no opportunity of seeing both tested. Agricultural experience has shown in all countries that high cultivation *pays* best, and the tea plant is no exception to the general rule.

In estimating the probable yield of tea per acre in the table below, the following is assumed:—1. That the climate is a good one for tea, though possibly not the best obtainable. 2. That the soil is of an average degree of richness. 3. That the land is flat, or nearly so. 4. That the plants are hybrid and of a medium class. 5. That high cultivation is followed out, and that both the pruning and picking are done on the most approved methods.

The produce should then be about as follows:—

Year after Planting.	Yield in Maunds per Acre.	Equivalent in lbs. per Acre.
First	Nil	Nil
Second	Nil	Nil
Third	¾	60
Fourth	2	160
Fifth	4	320
Sixth	5	400
Seventh	6	480
Eighth and all subsequent years.	7	560

It is convenient to calculate tea by maunds, for pounds necessitate such lengthy figures. The maund here alluded to, however, is not the Indian maund; *that* is no fixed weight, but varies in many districts. The maund, as applied to tea, is an arbitrary measure, representing exactly eighty English pounds avoirdupois.

The results given in the table above will be exceeded on first-rate sites in first-rate climates; it is not right, however, to give exceptional, which are never fair results.

The Self-Fertilisation of Plants.—Mr. Thomas Meehan, one of the most acute and thoughtful of American botanists, has several times during the present year brought before the Philadelphia Academy of Natural Sciences the subject of the fertilisation of plants. He has observed that there are plants with conspicuous and attractive flowers, which are as much adapted to secure self-fertilisation as other flowers are for cross-fertilisation. One of his examples is the green-house annual, *Browallia elata*, belonging to the order Scrophulariaceæ, having an attractive blue flower. Not only does it produce abundance of perfect seeds without

insect aid, but also the entrance of an insect would ensure self-fertilisation. The style is nearly as long as the corolla-tube, and the slightly longer stamens are arranged closely around it. Two of the anthers are inverted over the stigma, and their connective is densely bearded, appearing like petaloid processes, completely closing the tube of the corolla. No insect can thrust its proboscis into the tube except through this mass; and if it has foreign pollen adherent to it, it will be cleaned off by the beard. Furthermore, the very act of penetration will thrust the anthers forward on to the pistil, and aid in rupturing the pollen sacs, and securing self-fertilisation.

Another phenomenon, the "sleep" of plants, or closing of the flowers at nightfall, has been found by Mr. Meehan to have reference to self-fertilisation in *Claytonia virginica* (order Portulacaceæ) and some buttercups, which seed abundantly, without being visited by insects. In Claytonia, the stamens, on expanding, fall back on the petals expanded during daylight. At night, when the flower closes, the petals carry the anthers into close contact with the stigmas, and actual fertilisation only occurs in this way. In many cases, the stamens recurve so much as to be considerably doubled up by the nocturnal motion of the petals; thus the anthers are not brought into contact with the stigmas, and the flowers are barren.

In *Ranunculus bulbosus*, in the evening following the first day's expansion of the flower, Mr. Meehan has found the *immature* anthers and the young stigmas covered with pollen-grains. This would naturally be supposed to be the consequence of insect visits; but no insect visits had taken place in the cases examined. However, on carefully studying the flower it was found that coincidently with its expansion, a single outer series of stamens shed their pollen into the petals, from which it easily fell to the immature anthers and the stigmas when the flower closed for the night. Another equally remarkable instance of self-fertilisation occurs in *R. abortivus*, whose petals do not close at night. It seeds profusely, yet is wholly neglected by insects, notwithstanding that it possesses large nectariferous glands. Instead of the flower closing, the slender pedicles droop at night, inverting the flower, and thus allowing the pollen to fall from the petals, on which it is shed, upon the stigmas. Mr. Meehan concludes that some deeper purpose than has yet been conceived governs the fertilisation of plants. In view of these examples, nature cannot "abhor" in-and-in-breeding, and it can hardly be that colour, fragrance, and honeyed secretion in flowers have been developed solely to secure cross-fertilisation. Evolutionists will await with interest further researches by Mr. Meehan, and confirmatory evidences from other inquirers. — *Nature.*

A New Plant for Cattle Feeding.—Under the above title some attention has recently been directed to a boraginaceous plant—a close ally to our common comfrey—for extensive cultivation as a fodder plant. It is known as the Caucasian prickly comfrey, and is the *Lymphytum asperrimum* of botanists. Though the plant is spoken of as a novelty for cattle feeding, its adaptability for such has been known for some years, and an analysis has been made by Professor Voelcker. It was introduced to this country from the Caucasus at the early part of the present century, more as an ornamental plant, on account of its bold foliage and light blue flowers, than for any useful purpose. The recommendation of agriculturists some few years since, to grow it extensively as a green fodder plant was

not at the time followed up, and now that the plant has come before the agriculturist again, and that crowns and root cuttings suitable for planting are actually advertised at 5*l.* per 1,000, it is to be hoped that it may have a fair trial. This particular species of comfrey is described as being specially adapted for the feeding and fattening of stock, and for increasing the yield of milk in cows. Its growth is more rapid and luxuriant than any other green soiling plant, producing on a given space a larger yield than any other crop. Good grass land yields 8 tons of grass to the acre, cut green, lucerne 40, rye grass 50, vetches 20, while comfrey gives from 80 to 120 tons; whether this return would be similar on all sides can only be authenticated by continued cultivation and experiment. It is, however, a deep-rooted plant, and is to a certain extent independent of weather and climate, for in the dryest and hottest seasons it has been known to afford several heavy cuttings when most other vegetation is burnt up or suffering from drought. Other advantages are, that it comes earlier than any other crop and lasts longer, frequently affording forage until it is cut down by severe frosts. Above and around the root-stem, are shoots or suckers which can be taken off for planting and the roots sub-divided, so that the plant can be successfully and easily propagated; the planting may be made at all seasons except during frosts.

Its cultivation is simple and not costly. The ground should be ploughed six or eight inches deep and then manured, the cuttings should then be planted like potato sets about three feet apart. In winter the roots should be well dressed with ordinary manure or sewage. Besides its use as a green food, when dried into hay it also forms an excellent food for horses, cattle, sheep, pigs, &c. The juice of the plant contains a quantity of gum and mucilage, but very little sugar.—*Journal of the Society of Arts.*

New Light on the Chemistry of Plants. — The experiments of Adolf Mayer, recently published in the proceedings of the Berlin Chemical Society, add another interesting fact to our knowledge of plant chemistry — namely, that certain plants liberate oxygen when exposed to the sunlight in an atmosphere perfectly free from carbonic acid. The plants which do this are those which contain acids, and the oxygen is the result of a reduction of the acid in the sunlight to some carbohydrate. To prove that this is really the case, Mayer says it is only necessary to place some leaves of a succulent plant, like a houseleek, in water which has been previously boiled to expel the carbonic acid, and then expose them to the strongest sunlight. If the plants have been kept for a while in the dark, they will, on being brought into the sunlight, give off oxygen gas. Mayer measured the quantity of gas given off per hour by a branch of *Bryophyllum calycinum* (one of the Orpine family), which occupied a space equal to twenty-eight cubic centimetres.

In the dark the branch consumed a quarter of a cubic centimetre per hour of oxygen, while in the sunshine it gave out more than twice that quantity of the gas. Of course after a certain time this action came to an end, as the quantity of free acid able to be decomposed ran low. The juice expressed from the branch, before it was exposed to the light, was decidedly acid; that which was expressed, after this reduction had taken place, was slightly alkaline. Similar experiments continued for a long time with this plant and with another succulent plant of the same family, the *Crassula arborescens*, yielded similar results. In another

experiment, where the gas evolved was collected by itself, it was tested and proved to be oxygen. This peculiar reduction process was also proved to take place in some species of *Sempervivum.* The nature of the acid in these plants is not yet known, although citric acid seems to be one of the free acids in the *Crassulaceæ.* Plants containing oxalic acid do not evolve oxygen, as this acid cannot be reduced. Mayer also discovered another interesting point in this connection. Plants of this kind, which had been kept in the dark until nearly all the starch had disappeared, when placed in sunlight, with carbonic acid excluded, again became rich in this substance, thus indicating the reduction of the acid to carbo-hydrates. The phenomenon which first suggested these experiments was one observed long since by Heyne and Link, that the leaves of certain *Crassulaceæ* tasted sour in the morning, and lost this taste towards noon.—*English Mechanic.*

The Fungus of the Potato Disease. — The potato disease, which originally appeared about the year 1844, and which attacks the potatoes every summer with more or less virulence, has long been known to be produced by a fungus; but botanists have for years been vainly trying to find out what becomes of this fungus during the ten months of the year when it was hidden out of sight, believing that, if they could trace it during this period, a cure might possibly be effected.

Mr. Worthington G. Smith, a member of the Scientific Committee of the Royal Horticultural Society, considers that he has made this long-sought-for discovery, inasmuch as he has kept the potato fungus alive (though dormant) during the whole of last autumn, winter, and spring. For this service he has received the Society's Gold Knightian Medal.

The potato fungus is a parasitic plant, too small to be seen except under a high magnifying power.

The potato fungus, which is named *Peronospora infestans*, emerges in the form of fine threads from out of the innumerable mouths or breathing pores of the leaves; these threads branch repeatedly, and at the top of each branch may be seen a spore or seed. When these spores or seeds fall off the branches on to the leaf, they burst, and the corrosive contents bore into the leaf and extend the disease. But the spores do not always germinate in this way. They frequently divide themselves into from three to eight portions; and when these portions emerge, each of these secondary spores or seeds is seen to be furnished with two tails. With these tails the seeds (named "zoospores") propel themselves rapidly about like animals for many hours, or even days. Sometimes they rush into the mouths of the plant and swim about in the spaces between the cells. At last they come to rest, burst, and extend the disease by their corrosive spawn-threads. If these spores are dropped upon perfectly healthy leaves, they penetrate the tissues and cause the murrain.

Mr. Smith noted the winter life of the fungus by gathering a number of badly-infected leaves into a moist dark place. This treatment caused an unusually luxuriant growth of spawn threads, and new organisms were thus produced. The larger of these bodies was female and the smaller male. The male has a fine beak, he attaches himself to, and pierces the female, and it is this pierced female body which carries on the life of the fungus. If it falls upon a dry place it dies, but if it alights on a moist place it remains alive, though dormant, till the following June or July. Then its brown warty outer coat cracks into numerous fragments, and the contents emerge either as

threads or as seeds furnished with two tails. The first breath of air carries them from the moist earth in every direction. Such as do not now alight on potato plants perish, but such as do, at once renew the murrain for the season, and so prolong the life of the pest from one year to another.

Almost equally as destructive as the potato-fungus proper is a second fungus, which is the direct cause of putrescence in potatoes. This parasite is named *Fusisporium solani.* Till the recent spring, when Mr. Smith made out and illustrated its winter life, this fungus appeared and disappeared quite as mysteriously as its brother parasite. It undergoes a long period of dormancy in decaying vegetable matter in the form of small spores or seeds.—*Graphic.*

Flowers and their Colours.—While the green colour of leaves absolutely requires, for its formation, the action of light, there is by no means such a dependence in the colour of flowers on light. From experiments made many years ago by Sachs, it appeared that not merely bulbous and tuberous plants took quite a normal form in perfectly dark chambers, and gave coloured flowers, but that other plants also produced normal flowers, when the flowers only were kept in a dark space, and the green leaves exposed to light. At the same time differences were now and again observed, in the various plants, between the illuminated and the darkened flowers, and they seemed to call for further experiment. The matter has been investigated by M. Askenasy, who has described his results in the *Botanische Zeitung.*

It was found that Tulipa Gesneriana gave, in darkness, quite the same flowers as in light, and the flowers of the plants grown in darkness were in no wise altered, when they were afterwards brought to the light, and the etiolated stems and leaves became green. The same result was obtained from *Crocus vernus.* On the other hand, *Hyacinthus orientalis* showed a distinct influence of light, and that in two ways: first, the light accelerated the development of the flowers about fourteen days; then the flowers which grew in the dark were not indeed colourless, but the intensity of the colour was less, and its distribution was different from that in normal flowers. If the upper part of a cluster of flowers grown in darkness was cut off and exposed to light, there was, even after one day's action, a decided increase in the intensity of the colour, and in three days the flowers were nearly as deeply coloured as the normal flowers. "It is not without significance," M. Askenasy remarks, "that the change of colour which the light here produces is independent of the previous formation of chlorophyll. The older flowers, which had been earlier produced in the darkness, did not first become green, then blue; they rather at once took a dark blue colour, and only the younger flower buds formed at first chlorophyll in the light, so that they became at first as green as the buds of the same age grown in light, and afterwards developed in the same way as these."

Scilla campanulata, developed, in the dark, normal flowers, in which the blue colour of the corolla was somewhat weaker than the uncovered specimens, while the reddish colour of the inflorescence of the normal plants was absent in the darkened ones. *Pulmonaria officinalis,* on the other hand, developed its flowers in darkness from the flower-buds quite normally; and also in the darkness the change of colour proper to this flower passed from red to blue, but the flowers that were developed later were more weakly coloured.

Further experiments were made with *Archis ustulata, Silene pendula, Antirrhinum majus,* and *Pru-*

nella grandiflora, and the results were similar to those that have been described. The author makes the following remarks in conclusion:—"The experiments here described show that many flowers need light to acquire their normal colouration, while others can dispense with it. Wherein lies the ground of this difference does not yet appear, and numerous further experiments will be necessary before the phenomena can be reduced to order. In most of my experiments the individual flower-bearing shoots were brought entirely into the dark. Objection might perhaps be taken on this score to the value of such evidence, and the phenomena observed be partly attributed to defective nutrition. But the experimental plants were, in all cases, perennial growths, furnished with many subterranean parts, which of course contained abundant quantities of reserve material; there were also present, in most cases, numerous uncovered shoots in connection with those in the dark, and which could bring nutriment to the latter; still I did not give special care to this point. But, above all, the fact was to me decisive that the flowers formed under exclusion of light presented a normal size and form. Under such circumstances it would be a highly-forced view to attribute the absence of colouring matter to defective nutrition."—*English Mechanic.*

Potato Planting.—It may be well to remind amateurs, that after experiments innumerable have been tried with potatoes to enable them to withstand disease, or with a view to assist their escaping its attacks, little or nothing has been effected except by showing clearly that no dependence can be placed upon any method but growing early and second early kinds, with the seed properly prepared by being wintered cool, with as much light as possible, to produce strong tough sprouts, which will render them less liable to get injured or broken off in planting; by the avoidance of rank stimulating manures; and by planting sufficiently early, to admit of the crop being ready for lifting before the time that the disease usually becomes virulent. With this view I should advise that all garden ground intended to be cropped with potatoes—as soon as it is dry enough to be prepared for planting—should immediately be got ready. In early planting there is undoubtedly some danger from spring frosts after the plants appear above ground, but, by keeping them earthed up, the danger may be mitigated, and far less mischief will occur from the young leaves being slightly injured by frost, than by the crop being late and exposed to entire destruction by disease.—*Garden.*

IV.—GEOGRAPHICAL NOTES AND TRAVELLERS' TALES.

Exploring Work in Palestine.—Lieut. Conder, addressing the Scientific Conference at South Kensington in the beginning of June, furnished an account of the exploring work recently accomplished in Palestine. Within five years 4,600 out of 6,000 square miles of country had been surveyed, and nearly 4,000 heights measured. The position of three-fourths of the Biblical towns had been set at rest, and the true site of the Cave of Adullam and also of the Ford of Baptism of the Jordan had been ascertained.

Sand Hills in Motion.—A proof of the movement of sand-hills with the prevailing wind has been afforded by a revision of the survey made some years ago in Southern India. It was found on searching for one of the old stations in a group of sand-hills, that it had been moved 1,060 yards to the E. S. E., or at the rate of 17 yards per annum.

The Suez Canal.—The filling up of the Suez Canal may now be considered indefinitely postponed. Last year between the two seas, only 52,700 cubic metres of "stuff" were removed, and the canal was navigated with facility by steamers drawing as much as 27ft., and over 400 ft. in length. The bed of salt which forms the bottom of the Bitter Lakes, is gradually dissolving, so that this portion of the canal is being steadily improved.

Rains, Floods, Rivers, and Seas.—According to a French serial, the quantity of water which is poured night and day into the ocean is equal to that which would be furnished by 2,000 rivers of the capacity of the Seine when full. But this is a mere atom to the amount accumulated in the oceans. Assuming the mean depth of oceans to be about five kilometres, the entire volume of water in them would be about two thousand milliards of cubic kilometres. Two thousand Seines, full, would only produce about 200 cubic kilometres of water per twenty-four hours, so that they would have to flow night and day, without interruption, for *thirty thousand years*, to fill these abysses. And this is supposing no loss through evaporation. Yet this immense volume in the sea-basins is but small in comparison with the total volume of the earth; not so much as the half-thousandth part of it. The rain which fell in February last in Paris was equivalent to a quantity of 4,500,000 cubic metres over the whole city. This mass of water brought 88,000 kilos. of mineral matter, in which were observed a multitude of iron globules attractable by the magnet, and probably from meteoric combustions. There were not less than 170,000 kilos. of organic matter, produced partly by emanations from the city, but composed partly also of germs of sporules, or even of living infusoria. This February rain must have brought to the capital more than 9,000 kilos. of ammonia, an aërial manure which the plants would have appropriated had the Parisian land been covered with forests and inundated meadows as in the good old times of Camulogène.

A Magnetic Island.—The vol-

canic rocks composing the foundation of the Isle St. Paul are ferruginous. Those on the north side of the crater, which result from the slips whereby all the east side of the mountain is laid bare, attract the two poles of a magnet, and contain six per cent. of iron. Those met with around the cones of scoriæ situated at the foot of the exterior slopes of the crater, on the sea shore, are true magnets with two poles, containing fourteen per cent. of iron. The observations made for declination and inclination indicate the local action of a south pole towards the centre of the crater, a fact which should warn navigators to guard against the magnetic influence of this isle.—*A. Cazin*, in *Comptes Rendus*.

Arctic Discovery. — Captain Souter, of the *Intrepid*, from Davis Straits' whale-fishing, reports that while anchored in Isabella Bay, he found it necessary, in consequence of the great body of ice coming down, to proceed in shore. After sailing some distance he came into a fine, commodious, natural harbour, not marked in charts. There was nothing to show it had ever been entered before. Captain Souter and other officers left in a cairn a writing indicating the discovery. Splendid water was found, and there was less of the Arctic appearance than usual about the locality.

A Boiling Lake. — The discovery of a boiling lake in the island of Dominica has excited much scientific interest, and investigations of the phenomenon are to be made by geologists. It appears that a company exploring the steep and forest-covered mountains behind the town of Rosseau came upon the boiling lake, about 2,500 ft. above the sea level, and two miles in circumference. On the wind clearing away, for a moment, the clouds of sulphurous steam with which the lake was covered, a mound of water was seen ten feet higher than the general level of the surface, caused by ebullition. The margin of the lake consists of beds of sulphur, and its overflow found exit by a waterfall of great height.

The Deepest Sea-sounding on Record.—H.M.S. *Challenger*, in the course of her wanderings has taken the deepest sea-soundings on record, one of 4,600 fathoms being to the north of New Guinea, where the ocean is more than five miles in depth. This is a very exceptional measurement, the average depth of the Pacific being 3,500 fathoms, and that of the Atlantic 2,500. Compared with these vast immensities, the seas which so often lash themselves into fury upon our own coasts would be deemed shallow indeed. There is no doubt whatever that, if our corner of Europe were raised only 100 fathoms – half as high again as St. Paul's — the beds of the English and Irish Channels, and very nearly the whole of the North Sea, would be dry, the British Islands would be united and joined to the Continent, and a large expanse of land would be added west of Scotland and Ireland. The real basin of the Atlantic begins with a very sudden declivity, and the basin of the Pacific declines in an equally sudden manner. It has been ascertained by those on board the *Challenger* that the water at the deepest parts of the ocean is scarcely at all denser than at the surface.

Ocean Circulation.—Professor Wyville Thompson, director of the civilian scientific staff on board the *Challenger*, reports to the Admiralty that the trough of the Pacific Ocean, like that of the Atlantic, is filled by an enormous mass of cold water near the bottom, which appears to be an indraught from the Antarctic Ocean, and constantly moving northward. "The more the question is investigated," he says, "the less evidence there seems to me to be of any

general ocean circulation depending upon differences of specific gravity."

On the Islands of Chincha.—According to M. Habel, it is a mistake to suppose that the accumulation of guano on the islands of Chincha consists of the excrements of sea-birds inhabiting these islands. In reality, it is composed of two strata, differing both in the mode and date of their origin. The upper stratum, far the smaller, is composed of the excrements and bodies of birds and seals now occupying these islands. The lower stratum took its commencement in prehistoric times from the excrements of birds, let fall to the bottom of the sea, only a limited portion of which was occupied by these birds. The stratum thus formed has been since raised (as still occurs in the present day), at the same time as the bottom of the sea, and the islands themselves are only the result of these upheavals.

The Islands of the Coral Sea.—A paper on this subject was read before the British Association by Mr. Kerry Nicholls. The Coral Sea embraces that portion of the Pacific Ocean extending from the south of New Guinea, westward to the coast of Australia, southward to New Caledonia, and eastward to the New Hebrides. The New Hebrides' banks and Santa Cruz Islands, he said, constitute an almost continuous chain of fertile volcanic islands, extending for a distance of 700 miles, between the parallels of 9° 45′, and 20° 16′ south latitude, and the meridians of 165° 40′, and 170° 33′ east longitude. Espiritu Santo, the largest island of the archipelago, was seventy-five miles long, and forty miles broad. The geological formation of the islands was composed of volcanic and sedimentary rocks. The chain of primary volcanic upheaval might be traced running in a general course longitudinally through the islands always in their longest direction, the axis of eruption being marked by active and quiescent volcanoes. On the north end of the island of Vanu Lava there were extensive springs of boiling water, solfataros, and fumaroles. The hot springs were of two kinds—some were permanent fountains where water was in a constant state of ebullition, others were only intermittent, and the water became heated at certain intervals, when it varied from a tepid degree of heat to boiling point. The physical features of the islands were remarkably bold, and betokened at first sight their volcanic origin. The plains, table lands, and valleys of the mountain region were, many of them, of considerable extent.

A River of Ink.—In Algeria there is a river of genuine ink. It is formed by the union of two streams—one coming from a region of ferruginous soil, the other draining a peat swamp. The water of the former is strongly impregnated with iron; that of the latter with gallic acid. When the two waters mingle, the acid of the one unites with the iron of the other, forming a true ink.

"The Italy of the Far East."—The Japanese Ambassadors who concluded the treaty with Corea, pretend that there is not a more wretched country on the face of the globe than the one with which they are about to establish commercial relations. The people produce nothing, they have nothing, and they want nothing. It is, however, some consolation to know that in this corner of the earth, which some travellers have found so highly favoured by nature that they have thought it worthy to be called the Italy of the Far East, living is not dear:—

A working man, says the St. Petersburg correspondent of the *Standard*, can support himself daily on a sum which in English money would amount to something like the tenth part of a farthing. Every-

body is poor, and the whole expenses of the Administration do not exceed 1,300*l.* or 1,400*l.* a year. But though the Japanese pretend to be so disappointed with the country, they still think it worth while to send a representative to the capital, and they must not be surprised if other nations decline to accept their accounts as strictly accurate, and that they should endeavour to obtain the advantages which the Japanese have secured. The Russians will probably be among the first to follow the example of the Japanese, as at Vladivastok, their chief station on the eastern coast of Siberia, provisions of all kinds are exceedingly dear, whereas the Coreans have splendid pasturage with abundance of cattle near the Russian frontier. Such at least is the belief of the Russians, but they have not been able to take advantage of the plenty that is within their reach, as, according to the Corean laws, every foreigner who crosses the border is beheaded without mercy. But though the Russians do not venture into Corea, the Coreans are very glad to come to Russia. Many of them have settled in Siberia, and they are said to be excellent agriculturists; so that the Japanese accounts of the poverty of the country would seem like a weak device to prevent others from having a desire to share the advantages they have obtained.

A Lake of Seething Hot Water.—Shetland papers state that two enterprising Icelanders, named Jow Thorkelksson and Sigindur Kraksson, have explored the volcanic region of the Dygyur Jelden. They started on their hazardous expedition from the Bardadal on the 7th of February, and in the course of their two days' exploration they succeeded, under great difficulties and dangers, in descending into the crater of the volcano Asya, where, at about 3,000 feet below the upper margin they reached the bottom, and found themselves on the brink of a lake of seething hot water, which was apparently of great depth. Near the southern extremity of this lake the ground was broken up by fissures and pools, which prevented further progress in that direction, while the entire space resounded with the noise of loud subterranean thunder.

The English Cemetery at Scutari.—"So much was said," remarks Mr. C. E. Howard Vincent, "as to the state into which the nation had allowed the Crimean cemeteries to fall, that the friends of those who sleep in the English cemetery at Scutari may be glad to learn how perfect is the condition in which it is maintained. Serg. Lyne, late of the Royal Engineers, is the custodian, and he makes the most of the lovely site overhanging the blue Marmora. Hardly a grave is without floral surroundings, grass neatly mown, and paths without a weed. I visited it recently, with a Turkish officer of the staff, and he was struck, as well he might be, with the difference between the care bestowed by Christians on the graves of the departed, and the utter ruin of the Mahomedan cemeteries hard by. Acre upon acre they stretch, in hideous, fearful chaos. I took my companion at once to the tombs of the officers of my late regiment who had died of wounds or disease on the Asiatic shore. 'In vain,' he said, 'might I thus look for the resting-place of a friend.' The building which was used as a British hospital is now occupied by the 1st Regt. of Imperial Artillery —a very fine corps; and the room which Miss Nightingale made use of is pointed out with interest to all visitors."

The Present Appearance of Sebastopol.—"On the highest ground of the city south of the harbour," says Mr. Reed, in a letter

to the *Times*, "a magnificent church, of a style unknown in England, but of exquisite proportions, and of a beauty which grows rapidly upon you, has been erected by voluntary contributions over the graves of several distinguished admirals who were killed during the war. It is nearly finished, and is named after St. Wladimir, as is also another fine church building from funds similarly supplied, which is being constructed at a short distance from Sebastopol, on the sea shore, over the spot on which Wladimir is said to have embraced Christianity in the tenth century. After a short drive through the town, I accompanied Admiral Popoff to the Malakoff Hill, and there had the advantage of hearing him—who performed so active a part during the war, both by sea and in the field—describe the great outlines of the famous battle-fields, filling much of them in with details which to this hour are of thrilling interest. We afterwards visited the site of the fourth bastion, on the more southern part of the field, thus completing the general view of the Russian positions and of the principal points from which the allied troops attacked. The day was singularly fine and clear, and it was easy to see not only such conspicuous objects as Lord Raglan's headquarters, the Hill of Inkermann, the principal French and English batteries, and the French cemetery, but also such details as the English trenches in front of the Redan, observing that the ravages of time and tourists are rapidly obliterating these lesser features of the fields over which the gods of war fought and thundered. Such a visit as mine impresses one strongly with the waste as well as the havoc of war. In the cemetery over yonder, made conspicuous by a pyramid church surmounted with a cross, and in another near, lie, as I am informed, more than 100,000 Russian men killed during the siege. Many balls and many bullets must, therefore, have taken effect. But those that did were, nevertheless, but few indeed compared with those that the allies projected against this devoted place. There are scores upon scores of large buildings with their surfaces pitted all over with scars caused by shot and shell that produced nothing but scars upon buildings. A faint idea may be formed, perhaps, of the extent to which the place was fired upon when I say that from a tax of 6*d.* per cwt. which the Government levied upon the proceeds of the sales of old iron, shot, and shell, picked up and sold by the people, a sum of nearly 15,000*l.* was realised."

Ruined and Deserted in the Steppes of Turkestan.—The Russians have discovered the ruins of a large town in the steppes near the Atrek. Several minarets, in the Arab style, are still in a good state of preservation. The vicinity of this place is said by the Turkmen to have been very fertile in former times, and there exist traces of an extensive system of irrigation.—*Geographical Magazine.*

An Inland Sea in Africa.—In one of his reports, Vice-Consul Dupuis says:—The project of submerging the region of Djerid by means of a canal is based upon a fact clearly recorded—viz., the presence of water, in the form of lakes, in the line of the great depressions, and upon the presumption that these lakes were themselves but the residue of some vaster body of water or inland sea, which disappeared at a still earlier date from the surface, owing, it is conjectured, to the formation of an isthmus, which cut it off from the Mediterranean with which it was connected.

The recent surveys, though they reject the idea of any connection with the Mediterranean having existed—a hasty conclusion based

upon mere inferiority of level to that of the sea—would seem to endorse the fact of all the region having been under water. Indeed, had there existed a connection, it is presumable that more than a mere incidental reference would have come down to us regarding so large an arm of the sea, as in that case it would have been indenting the land, and therefore available for the purposes of war or commerce by the ancients. The results obtained prove that the sands are of but secondary importance on the isthmus, which is chiefly composed of alternate strata of grey quartz and ferruginous freestone, which rise at an angle of sixty degrees, and lie over another stratum of chalk. This excludes all notion, therefore, of any choking up of an early passage for the waters. No reference is made to waters in the depressions by Arab writers, probably on account of their insignificance at the date of their conquest, yet all unite in describing this country as having been very woody, but state that the wood was all cut down to facilitate the subjection of the tribes, who, for upwards of a century after, fought desperately for their independence, as well as during their own internecine wars which followed. According to them the country was well supplied with streams and abundance of water, a statement itself in harmony with the notion of a degree of atmospheric humidity conducive of luxuriant vegetation, and presupposing the cause which alone could bring it about.

Whole regions, therefore, now condemned to sterility, with, save perhaps an oasis here and there, were formerly rich in pastures, and interspersed with towns. The desert, which has gradually extended in regions lying between Tripoli and Egypt until it has reached the sea, covering districts once fertile, and burying Egyptian ruins, has, beyond doubt, similarly encroached on the Tunisian southern frontier between it and Tripoli. The diminished heights and lowering of the Atlas range, let in the sands carried by every southerly wind, notably by the periodical south and south-east winds, to which the more elevated and uniform heights of the mountain system oppose a formidable barrier in more favoured Barbary States westward. In Morocco, especially, these same winds are so tempered in their passage across the intervening heights as hardly to be recognised as the same which here dry up and parch the land in summer. It may therefore be presumed that the disappearance of the waters in question is due to the encroachment of the desert, caused by the action of these winds during a long succession of centuries, aided by absorption and by co-operation occasioned by the presence of the vast scorching desert to which their own southern aspect left them fully exposed. To these causes may also be added the substances brought down by streams, which, by all accounts, were many; these, by narrowing the margins and spreading the waters, helped the work of desiccation, which was accelerated, moreover, by a decrease in the pluvial supplies consequent on the disappearance of mediæval forest. There can be no doubt about the drying up of many of the streams here, as elsewhere in Barbary, being due to the clearing away of forest, whether in the plains or in the highlands, by the Arabs on their conquest and after. The consequence is, that the periodical rains, which at an earlier date fertilised the country, were replaced by heavier but rarer falls, the waters of which rush down the slopes and disappear in the sands, or mix with the noxious waters of the lagoons ere they penetrate and salinate the soil to any depth. The action of

these passing waters is seen in a wasting away of earth and exposure of naked rock in all the "Hamayed," or elevated lands, hill sides, or ravines.

When it is considered that the regency of Tunis is a lake country, and that recent discoveries have brought to light similar vast sheets of water in Africa, the existence of an inland sea may not seem such a startling idea.

Exploration in New Guinea.—A paper was read before the British Association by Signor G. E. Cerruti on his recent exploration in New Guinea on a special mission appointed by the King of Italy. He said that part of the globe had created some sensation in the world, especially in Great Britain. It was a very rich and fertile country, which before long would, he believed, be occupied by some civilized nation. In 1861, while in Melbourne, he found some shipwrecked seamen, and among them an Italian. They had been wrecked on the coast of Guinea, and the Italian gave him his first idea of that country. Sailorlike, he told so many yarns about it that if he had believed him he would only have had to go to the island, load a vessel with copper, and return home a rich man. He joined with a Scotch engineer in the effort to organise an expedition, but there was a difficulty as to money which they could not get over. Some time afterwards, however, he contrived to pay a visit to some of the Northern Islands of the Archipelago, after which he proceeded to China and Japan. After some years he obtained a yacht of his own and explored the Northern Islands again.

In 1866 he paid another visit to that part of the world, and when he returned home he found the Italian Government very anxious to form a penal settlement in New Guinea, and as he knew the then Prime Minister, Count Menabrea, now Italian Ambassador at the Court of St. James, he was commissioned to proceed to New Guinea and study the question, whether it was possible to colonise some of the island, and also form a penal settlement?

His voyage was made in the years 1869 and 1870, and he was enabled to say that a country richer in all kinds of vegetation he never saw, although he had travelled in all parts of the world; its trees and plants were giants compared with any he had ever seen elsewhere. The island produced infinitely more food than was required by the natives. In reference to the latter he might say that inland he found a different race from that which inhabited the coast, and he believed those inland were the descendants of the original inhabitants of New Guinea. If scores of millions of people were sent there they would find plenty of means of bettering their condition. A man had only to throw a handful of Indian corn in the bush, and in forty or fifty days it would yield abundantly.

The natives were very friendly, but they were revengeful if ill-treated. What they feared was that the visitor wished to deal in imported labour, a system which ought by all means to be put down. Cameron had done much to pave the way for putting down slavery in Central Africa. He hoped that Great Britain would do all in her power to put down slavery in the Pacific. Let her encourage emigration, not only from home but from China. She had given many examples of energy in the matter of colonisation, he hoped she would give another in the direction to which he pointed.

In the discussion which followed the reading of this paper, Mr. K. Nicholls confirmed all that Signor Cerruti had said as to the fertility of the island in question. When there, he was told that if slate pencils were planted they would

produce copy-books. That, of course, was a pleasant exaggeration, but the great fertility of the soil could not be doubted. He had much doubt as to the policy of a large emigration of Chinese, the result of which was seen in the Pacific States. The Chinese were in the abstract industrious, but they were dangerous competitors. They readily entered into contracts, but it was nearly impossible to make them abide by their agreements. He believed the Coolies from India would cultivate the soil without objections which resulted from a large importation of Chinese.

The Khan's Palace in Khokand.—The *Invalide Russe* publishes the following details of the Khan's palace at Khokand:—

On Sept. 15, the Russian troops passed through the chief town of Khokand, the great majority of whose inhabitants looked on the Russians with more of friendliness than of suspicion. The Khan met the Commander-in-Chief at the doors of the palace. General Kaufmann, alighting from his horse, saluted the Khan, and, attended by his suite, ascended an eminence near the entrance to the palace. When all the troops had been drawn up, the Commander-in-Chief entered the palace with the Khan. The building is a very commonplace erection. The entrance resembles that of a Turkestan mosque—a hall surmounted by a dome. From its inner door you enter a large room, also vaulted, and from which a corridor leads to the first court, around which there are open galleries. Inside this court is a second one, and opposite to its entrance stands the palace. The entrance door of the palace is placed at a considerable height, and the inclined plane which leads up to it occupies about the whole width of the yard, and is difficult of ascent. The room in which the Khan received the Commander-in-Chief and his attendants was splendid from an Eastern point of view. The ceiling was covered with paintings, the walls with varnished and painted tiles, and the floor with carpets and silk coverlets wadded. Near these stood European armchairs and seats. From the ceiling hung three chandeliers, the middle one of large size, suspended by a thin chain, and descending almost to the floor. On the walls were four European mirrors, a fifth mirror being fixed in a niche of the wall opposite the entrance. There was here also a small eminence covered with carpets. On the eminence stood two armchairs, and between them and the large chandelier was a table on which were spread refreshments of a very ordinary nature—some tea, pilau, and fruits. Before partaking of them, the Khan proposed to the Commander-in-Chief to inspect the other part of the palace. Accordingly, after having passed a third small court, we came to a portion of the building which was still in process of construction. Some small rooms, with curtained windows and small divans, before which stood round tables and armchairs, were just finished. The floors were covered with pretty carpets, and the hangings were quite new.

A Visit to Pitcairn Island.—The following are extracts from a letter received from the commander of H.M.S. *Petrel*, reporting his visit to Pitcairn Island in Dec. 1875:—

I found the inhabitants of Pitcairn in a flourishing condition, and well supplied with the necessaries required to meet their simple wants. They at present number eighty-five, a large proportion being young children. The numbers of the sexes are thirty-eight males and forty-seven females, the names of the different families being Christian, Young, M'Coy, Buffett, Warren, and Butler. Warren and Butler are not descendants of the mutineers. Warren married one of the Pitcairn Islanders in Norfolk Island, and accompanied

them on their return. Butler is an American, who a few months ago was cast away in an English ship, and when the remainder of the crew were taken off the island desired to be left behind. He has since married.

During last year there were two shipwrecked crews received on the island. The first was the crew of the English ship *Khandish*, bound to Europe, from San Francisco, with grain. While standing off and on, she stood too close in, missed stays, and went on shore on the north-east end of the island, close to Bounty Bay, and, being an iron ship, soon became a total wreck; her crew were taken off a few days afterwards by a passing American ship. The others were the crew of the English ship *Cornwallis*, which ship, being also on her passage home from San Francisco with grain, went on shore and became a total wreck on the Island of Oeno. They took to their boats, and made for Pitcairn Island, where they remained for more than six weeks, when they were taken off by a passing vessel. The crew of the *Cornwallis* numbered twenty-five, and as they were so long on the island it caused the inhabitants to be a little straitened for garden produce; but when by themselves they are amply supplied, and are able to supply passing ships liberally with vegetables and fruit; sheep, pigs, and poultry they can also spare.

Thursday Christian (who is the magistrate of the community) desired me to make known that they were in want of gardening tools, spades, hoes, and rakes. The islanders would be very grateful for a small number of these articles. If it was decided to supply them, I would suggest that the most ready means of forwarding them to the island would be through the consul at San Francisco, who might be instructed to purchase them, and forward them by the first homeward bound ship intending to touch at the island.

Christian informed me that a yearly average of eight or nine ships communicated with them, the vessels being either bound from San Francisco to Europe, or else from Newcastle, New South Wales, to San Francisco. Some of the grain-ships from San Francisco have called two or three years consecutively. From these vessels they obtain, in exchange for fresh provisions, their supplies of clothing, &c. With the exception of the gardening tools, we were enabled to supply them with the few things that they were in want of.

The inhabitants were very healthy, and, with the exception of one scrofulous child, there appeared to be no disease among them. They were very loyal in inquiring after the health of her Most Gracious Majesty and the Royal Family generally.

The New Route to Western China.—A report, addressed by Consul Sir R. Robertson to the British Minister at Pekin, has just been issued, which gives some valuable information respecting the new French settlements on the Gulf of Tonquin, and the means of communication they afford with Yunan:—

The province of Tonquin, which lies upon the gulf of that name, borders immediately on the southern and south-eastern frontiers of Yunan. It forms the most northern portion of the Annamite empire, which stretches along the eastern side of the broad tongue of land of which Burmah and Siam constitute the western. The French some years ago wrested from Annam its most southern province, Cambodia, and they have established a kind of protectorate over the rest of the empire. In the hope of getting into their hands the trade with Western China, they, a couple of years ago, obtained from the emperor a concession of two settlements in Tonquin, which they are opening to foreign trade.

From Consul Robertson's report, Tonquin appears to be a well-culti-

vated country, with a large, prosperous, and contented population, possessed of immense agricultural capabilities, and rich in various minerals, especially copper and tin. The French settlements are situated on branches of the Songkoi, or Red River, which rises in the mountains of Tibet, passes through Yunan, and finally, after dividing itself into a number of branches, flows into the Gulf of Tonquin.

One of these settlements, Haiphong, owes its existence altogether to the French. They have obtained a concession of about forty acres, which they are surrounding with a deep canal, raising the level of the settlement above the plain in which it stands by means of the earth dug out of the encircling canal. This settlement they are converting into a great fort, and apparently they mean to make the place the anchorage of foreign vessels. It is connected by the river and by canals with the second settlement, Hanoi, which is the capital of the province, and a large city of between 150,000 and 200,000 inhabitants. At this city they are founding a settlement similar to the former.

The city of Hanoi is said, by Sir R. Robertson, to contain good shops, and to be well supplied with provisions; but it has no foreign trade any more than Haiphong. When the snows melt, the Red River carries down so much deposit that the beds of the several branches are rapidly rising above the surrounding country, which they occasionally devastate with floods, but Consul Robertson thinks that they only need proper dredging. The main river is navigable beyond the Chinese frontier, a distance altogether of 414 miles.

With regard to the prospects of trade, they appear to depend on the adoption by the French of a more liberal policy, the co-operation in good faith with the French of the Annamite and Chinese Governments, and the clearing of the interior of banditti. The French Consul, who has charge of French interests in Tonquin, was about to start, when Sir R. Robertson was there, with a military force to clear the frontier towards China.

The Temperature of the Atlantic Ocean.—Before the geographical section of the British Association a paper was read by Staff Commander Tazard, R.N., on the temperature obtained in the Atlantic Ocean during the cruise of H.M.S. *Challenger*. The following is a summary of the paper:—

Over a great portion of the Atlantic the bottom temperature has this peculiarity—If the depth be less than 2,000 fathoms, we find the temperature at the bottom lower than that of any intermediate depth, but when the depth exceeds 2000 fathoms, we find that the bottom temperatures are nearly the same as they are at that depth. This holds good for three-fourths of this ocean. In the remaining fourth the temperature obtained at the bottom is much lower than in the other parts, and this fourth is not at either extreme, where there is a large current of surface cold, but occupies the whole of the western portion of the South Atlantic as far north as the Equator.

The results of these temperatures may be classified thus: If an imaginary line be drawn from French Guiana to the westernmost island of the Azores, and from thence north on the western side of this line, the bottom temperatures at depths exceeding 2000 fathoms are 35°—that is, taking the mean of all the temperatures obtained which differ but slightly. On the eastern side of this line the bottom temperatures are 35·3°, and this uniform temperature appears to extend as far south as Tristan d'Acunha, as the German frigate *Gazelle* obtained similar bottom temperatures eastward of the

line joining that island with Ascension to the southward of a line joining Tristan d'Acunha with the Cape of Good Hope. The bottom temperatures are decidedly colder between the eastern coast of South America and a line joining Tristan d'Acunha and Ascension Island; and from the Equator to the southward the bottom temperatures were invariably colder than at any intermediate depth. These temperatures varied from 31° to 33° 5′, that is when the depth exceeds 2000 fathoms, and temperatures of less than 33° were found as far north as the Equator, while a few miles northward this bottom temperature was 35°. It therefore appears that in the western portion of the South Atlantic the highest bottom temperature is less than the lowest obtained elsewhere in this ocean, excepting where the very low result of 29° was found by the *Porcupine* in 1869 between the Faroe Isles and the North extreme of Scotland. The question thus arises as to the causes which confine this cold water to the bottom portion of the western half of the South Atlantic.

The examination of the soundings which had been taken in this ocean, combined with the results of their temperature, leads to the conclusion that there is a series of ridges dividing its bed into two basins, one of which occupies the whole of the western portion of the North Atlantic, while the other extends the whole of the length of the ocean on its eastern side, and that the cold water in the western portion of the South Atlantic is owing to there being no communication between the bed of this portion of the ocean and the bed of the antarctic basin, and from the results of the serial temperatures soundings it would appear that these ridges cannot exceed 1950 or 2000 fathoms in depth. To ascertain the thermal condition of the Atlantic (from the surface to the bottom), serial temperatures were obtained in the *Challenger* at 125 positions, observations having been made at each 100 fathoms to 1500 fathoms in depth, and frequently at, say, 10 fathoms to 200 fathoms in depth, at each of these positions.

An examination of these temperatures shows that between the parallels of 40° N. and 40° S. there is a much larger amount of warm water in the North than in the South Atlantics, and that in the equatorial regions the isotherm of 60° is much nearer the surface than in the temperate zones, but that the isotherms below 60° are at nearly as great a depth at the Equator as in any part of the South Atlantic, especially at the isotherm of 40°, and that between the parallel of 30° and 40° north latitude, the isotherm of 60° occupies a depth of 300 fathoms, over an area of 1,200,000 square miles, while the average depth of this isotherm between the parallels of 30° and 40° south latitude is 160 fathoms; also that the isotherm of 40°, which is at an average depth of 800 fathoms across the North Atlantic, between the parallels of 30° and 40° north latitude, occupies only half that depth in any part of the South Atlantic.

This phenomena may be explained in the following manner:—The power of the sun indirectly heating the water below the surface appears not to extend below 100 fathoms even in the tropics, and this power decreases as the higher latitudes are reached, until a position is attained where the temperature is that of the freezing-point of salt water. As salt water at its temperature of congelation is denser than at any higher temperature, its weight would cause it to sink, and it would in time, did no other cause intervene, occupy the whole of the space in the ocean not influenced by the sun's heat. But in considering the effect of the heat imparted to the surfaces we have also to consider the effect of evaporation and precipitation. In the

equatorial regions evaporation is rapid, so that the surface film would become cleared through increased salinity were it not for the increased temperature and large precipitation, as well as to its being transported by the friction of the trade winds and the earth's motion to the westward. This surface film, constantly moving westward in the equatorial regions, meets in the Atlantic with an obstructing point of the South American continent, which directs it to the northward, so that the greater part of the water directly heated by the sun's rays in the tropical regions is forced into the North Atlantic. As the salinity of this water is greater than that of the subjacent layers, and its increased temperature only renders it less dense, directly a portion of this temperature escapes in the colder regions of the temperate zone, the surface film sinks and imparts heat to the water beneath. Consequently, the isotherms will be found at greater depths where the heated surface films are constantly descending than when, owing to their being less dense than the subjacent layers, they remain on the surface.

African Exploration by Captain Cameron.—A paper was read in April, by Captain, then Lieutenant, V. Lovett Cameron, R.N., on his journey across Africa from Bagamogo to Benguela, before the members of the Royal Geographical Society. The meeting was held at St. James's Hall.

Captain Cameron gave an outline of his expedition. He was first joined by his friend, Dr. Dillon, and subsequently by Mr. Murphy, R.A., who volunteered to accompany him, and afterwards, Mr. Moffat, of Natal, a nephew of Dr. Livingstone.

His first great difficulty on the East Coast was to obtain stores and men, but at the outset he had received most valuable assistance from Sir Bartle Frere. They had not long started with the expedition when Mr. Murphy was struck down with illness and Mr. Moffat remained with him. The expedition encountered many difficulties on its way from the East Coast to Ujuhha before they reached where Mr. Murphy joined them, with the sad intelligence that Mr. Moffat had died. He was thus prevented taking part in a work on which he had set his heart, and in the furtherance of which he was willing to spend the last farthing he possessed. In the Ujuhha district they met with several vexatious delays, principally traceable to the payment of tribute, sometimes the officials appointed to receive it being too drunk to transact even that business.

Captain Cameron then described the features of the country through which he passed, boulders of granite he encamped near—the largest he had ever seen, and trees so widespreading that 500 men could camp beneath their shade. In some districts the disposition of the people could not be trusted. They were hospitably inclined one day; the next they were hostile, and would retire into the jungle, leaving strangers to starve, believing that what would be left behind by the travellers would compensate them for the inconvenience to which they had put themselves in leaving their town or village. Sometimes they travelled through uninhabited tracts where game was plentiful and wild; sometimes over plains where the grass was twelve feet high, and each stalk an inch in circumference.

On the 5th of August, 1874, they reached Urura, the capital of Manyěma, the Arab chief of which place treated them hospitably, and they were escorted to the house in which Stanley had lived for some time. They had, out of courtesy, to visit all the Arabs of the town, and to eat with each one of them—a formidable duty to perform between 10 a.m. and

4 p.m. Here he, Dr. Dillon, and Mr. Murphy suffered from attacks of fever. During their stay he received a letter from Sir Samuel Baker, to which he sent a reply by the messengers bringing it.

Shortly afterwards Jacob Wainwright arrived with an account of Dr. Livingstone's death, and news that his corpse was near. Captain Cameron sent a bale of cloth to Dr. Livingstone's servants to assist them, and when the body of the illustrious explorer arrived, it was received by the principal Arabs with the utmost respect. Having made arrangements for the conveyance of the remains of Dr. Livingstone to the coast, he resolved to pursue his journey alone, Mr. Murphy and Dr. Dillon being compelled through ill-health to resign, and in a few days afterwards he received the news of the death of his old friend, Dr. Dillon, which was a great blow to him.

Captain Cameron then sketched his journey southwards to Kilemba, north-west of Lake Kassali, out of which runs the River Lualaba, joining the river Luvwa on its course between Lake Moera and Lake Lanji, some miles south of the latter. From Kilemba he travelled south-west to Ulomda, and finally westward to Benguela on the west coast. The difficulties he had to encounter were great from desertions, from the caprice of chiefs, from exactions, constant delays, and not infrequently from hostile attacks, in which he rarely retaliated, and never unless it was clear that the lives of his party and his own life were at stake. Some of the journals of Dr. Livingstone he recovered, and whenever he crossed the track of the great traveller he found that he was kindly remembered.

The slave trade could be—and could only be, in Captain Cameron's opinion—rooted out by legitimate trade, for which the nature of the country he traversed was well suited, and on the whole the disposition of the people would offer no difficulties. In one instance he had seen forty or fifty women brought into a town as slaves. Each was laden with spoils, and many had children in arms, and they represented some hundreds who had been massacred.

At the conclusion of the address, which was frequently interrupted with applause, Sir Henry Rawlinson said that, on behalf of the Council of the Society, he had to express the high opinion they entertained of the services rendered by Lieutenant Cameron to geography. They considered those services not only rendered to the cause of geography, but that they were of equal interest to the politician, the merchant, and the philanthropist. He trusted that one other and great result of the gallant exploit of Captain Cameron would be the suppression of slavery in the interior of Africa.

Captain Cameron in Equatorial Africa.—In addition to the abstract we have just given of Captain Cameron's paper read before the Geographical Society, we give an abstract of an address delivered by the intrepid explorer before the British Association.

Having briefly pointed out on the map the course of his travels from the east to the west coasts of the continent, Captain Cameron said that there was an advantage in dividing his journey into the various watersheds across which he passed. Each basin had its own peculiarity of products and inhabitants. On the east coast twenty days' marching took him to the great mountains of Usageri. In the open country the sugarcane was plentiful. The mountains in the district were principally granite. In Ujiji the country was broken up into two ranges of hills. The soil was sandy and sterile, and there were many great boulders of granite rising from the plain, some of enormous size. The inhabit-

ants, like their country, were a rugged race; but, owing to their having to work hard for their living, they were more industrious than those of most of the other countries of Africa; they possessed large herds of cattle, and they were, he believed, of Malay origin, and were similar in colour and distinctive marks to the people of Madagascar.

Next came a country with many streams running to the east. Those streams were joined together in the rainy season and formed a lake, from which a stream ran up to the Victoria Nyanza. The language of Zanzibar, he found, stretched right across that belt of the continent, although there were great differences of dialect.

Then he came to the basin of the Congo. At Ujiji he found the people very expert in navigation, and they possessed many canoes of 50 and 60 feet long. At one point, on the margin of the Tanganyika, he saw large masses of coal, although circumstances prevented him obtaining specimens. The people cultivated rice and the cotton plant, and made their own cotton clothes. Towards the south end of the lake very large rivers flowed. After rounding the south end of the lake he came to a country which was governed by a chief who had a very European appearance, and desired to become acquainted with European habits. Coasting up the lake, he found the country to be extremely mountainous.

After long travelling he reached the Lualaba, a large river more than a mile wide at its mouth; but his path was interrupted by floating vegetable matter two or three feet thick. The depth of the river was about three and a half fathoms; but his boat, though a strong Arab vessel, was almost jammed in vegetable obstruction. In the Manyuema district trees, nearly 300 feet high, were to be found, and from these large canoes were formed. There was also an abundance of smaller growth, affording excellent timber.

There was no tattooing among the inhabitants, as there had been among the people to the east. Their houses were of a reddish grey, their arms were spears principally, and they wore shields; but some used bows and arrows. The people were remarkably prolific, but constant wars were going on for the purpose of obtaining slaves. The people were cannibals, and often killed their enemies for the purpose of eating them. In the adjoining district iron was plentiful. The people worked large quantities of iron, and many of the articles they turned out were beautifully finished, although only hand-forged. The Lualaba was 1080 yards broad, and deep enough for a large steamer to work through.

The Arabs and Portuguese had for some years been endeavouring to obtain a footing in this country, but were opposed by hostile tribes. Most of the Arabs traded more in slaves than in ivory, a lesser number more in ivory than in slaves. He heard of coal in various directions, and of silver, and a chief called Pifs Pifs brought him some nuggets which he tested for gold. The chief asked whether the gold would do for shot for his gun, and had he not explained the value of the metal he was sure the chief would have let him have the whole of it. The country grew wheat in abundance, and was most fertile, but unhappily it was one vast slave-field. The Congo and the rivers which could so easily be joined with it were used for the conveyance of the slaves to the markets where they were sold.

By means of the Congo system the country could be reached from the west coast at a distance of 700 or 800 miles, instead of by the present route of some thousands of miles from Alexandria. The Portuguese had no other object in the district

than to obtain slaves. They obtained enormous numbers of slaves by the grossest cruelties, and great numbers were brought to the country of the Caffres to be sold. If any large, well-constituted scheme were formed to utilize the water communication to which he had referred, the great lake and river system of Central Africa might be opened up in two or three years. Of course, money would be required, and men to work it. He trusted that both would be forthcoming.

At the conclusion of the reading of this paper it occurred to somebody that the tribes who already occupy this territory would want some kind of government, and the Captain was asked how he got along without coming into contact with the natives. "By acting like a gentleman to them," was the reply; and he added, with an evident side-glance at recent events (*see* the following article), that he "always bore in mind, in the course of his journey, that to shoot any native wantonly and unnecessarily would retard and would likely endanger those who might be his successors in African travel;" a declaration which caused a burst of applause. Somebody else proposed a kind of joint company in Africa, but the general opinion seemed to be against the repetition of Indian experiments.

Central Africa.—After an interval of more than twelve months copious despatches were received in July, from Mr. Stanley, the leader of the *Daily Telegraph* and *New York Herald* expedition in Central Africa. Of the contents of these long-looked-for communications, the following is a brief summary:—

Mr. Stanley's first letter was dated July 29, 1875, from Mahyiga Island, in the Victoria Lake, and told his voyage from King Mtesa's territory back to the camp at Kagehyi, in the course of which his party narrowly escaped massacre by the treacherous natives of Bambireh. Escaping by the greatest skill and courage, the explorer encountered several storms on the lake, but arrived safely at his camp, after remarkable adventures.

The second despatch, dated Aug. 15, 1875, from Dumo, in Uganda, narrated a visit to the island of Ukerewe, and the voyage of the entire expedition in canoes to Uganda, with the severe punishment inflicted by Mr. Stanley upon the savages of Bambireh for their murderous treachery.

A third letter, under date of Jan. 18, 1876, written from Kawanga, on the frontiers of Unyoro, described how Mr. Stanley marched from King Mtesa's capital across country to the Albert Nyanza at the head of his own force and 2000 spearmen of Uganda, pitching his army upon the shores of the Albert at Unyampaka.

The incidents recounted in the first two despatches were of unequalled interest, and all three contained particulars of the highest geographical and ethnological value. On Jan. 18, Mr. Stanley arrived again at King Mtesa's, having twice made his way through the country of Kabba Rega, and visited but not navigated the Albert. Hence it was that Gessi, who sailed on that lake in the following April, heard nothing of the explorer. But Mr. Stanley had been the first to investigate the intervening land, which he described, including the remarkable mountain Gambaragara, and a strange tribe of pale-faced people who live on its cold uplands. Mr. Stanley christened the large inlet of the Albert where he was camped "Beatrice Gulf," after her Royal Highness Princess Beatrice, and he collected much material about the lake.

Yet another despatch, dated March 26, 1876, from Kafurro, in Central Africa, related the final de-

parture from Uganda, the exploration of the Kagera river, and of Speke's "Lake Windermere," as well as of the Hot Springs of Karagwe; and inclosed a sketch-map of the only portion of the Victoria Nyanza omitted in a previous chart.

Another letter, under date April 24, 1876, from Ubagwe, in Unyamwezi, recounted the further exploration of the interlacustrine lands, and Mr. Stanley's southward march towards Ujiji, whence he proposed to revisit the Albert by way of Tanganyika; and the spot whence this last despatch came was within fifteen days of Ujiji, which place it is to be hoped Mr. Stanley safely arrived at with men and means enough to solve the great problem which he would find still left open for his undaunted courage and splendid gifts as a traveller. He speaks of his white companion, Frank Pocock, as well, and of his own health as unimpaired.

The Voyage of the Challenger.—An interesting address on this subject was delivered at Glasgow by Sir Wyville Thomson during the meeting of the British Association.

Sir Wyville Thomson said the cruise, on the whole, had been a singularly fortunate one. It had only been in very exceptional circumstances that they had been prevented by the weather from doing their work. The health of the party had been generally good, and the number of losses by death had been exceptionally small. Two misfortunes only befell them in any way sufficiently grave to affect the success of the expedition. One of these was the loss by death of one of the most zealous and promising of their staff, Dr. Von Willemoes Suhm, which threw a gloom over the party; and the other was the recall of Captain Nares to take charge of the Arctic Expedition. He was singularly well fitted to take the command of such an expedition as that of the *Challenger*, and he had in a singular degree gained the confidence of all on board.

Before endeavouring to sketch one or two of the more general results at which they had arrived, he wished to make a few words of explanation on one or two points. He would have to bring before them various matters, which might to them appear entirely novel, but many of these were not in the stricter sense original. Many of them had been very shrewdly hinted at, or guessed at, from time to time; and many isolated observations had furnished clues which had been eagerly seized by students and made the basis of speculations, more or less touching the truth.

Among the many points of interest which engaged their attention, there were three which were specially prominent, and to which he would confine himself. The first of these was the contour of the bottom and nature of the deposits which were now being formed upon it; the second was the more difficult question of the distribution of deep sea climates; and the third point, perhaps the most curious and interesting of the three, was the nature and distribution of the peculiar race of animals which were now found upon the surface of the sea. In the first place, with regard to the condition of the bottom, he need scarcely go into detail, because it was more especially a hydrographic one. The average depth of the ocean appeared to be nearly 2500 fathoms. The bottom of the sea was covered with certain deposits; the whole of the bottom of the sea gradually recovering certain accumulations, and these accumulations were giving rise to formations which they looked upon as the rocks of the future, and it was one of the objects of the cruise of the *Challenger* to determine what

the deposits were, under what laws they were being laid down, and what the relations of these modern deposits might be to the ancient deposits forming the solid crust of the earth. The *débris* of the land extended for 100 miles out to the sea.

Many years ago it was determined by observation, even previous to the soundings for the first Atlantic cable, that over a great part of the North Atlantic a very remarkable deposit was being laid down—a deposit now well known under the name globigerina. This deposit consisted of the shells of minute foraminifera, of which the most predominant was the globigerina. This was a chambered shell, extremely minute, about a millimetre in diameter, and those shells were found in enormous quantities. The tow-net on the surface, and particularly at a little below the surface, brought up enormous quantities of these globigerina, and these presented characteristics totally different from the shells as they found them below, so that there could not be the slightest doubt that these shells were living on the surface and a little way below the surface, and that the whole of the material at the bottom, which was composed of these shells, was derived from the surface. The shell bristled with long spines running out from it in every direction, and in the interior there was a little animal, consisting of a particle of gelatinous matter. When the animal was alive, this matter ran out to the end of each of these spines, and absorbed minute particles of organic matter floating in the water. The gelatinous matter was almost of the same specific gravity as the water, so that probably it was moved in the sea by the slightest motion of the organic matter which composed its soft body, and the gelatinous matter being spread out in the manner he had described undoubtedly increased the surface of the animal, and prevented its sinking, so that these little creatures buoyed up in this way existed in millions on the surface of the sea, and there they were perpetually dying and sinking to the bottom, where these creatures abounded in water of 2000 fathoms. They had deep formations of lime proceeding at the present time, and these animals were living in the Atlantic, the Pacific, and the Southern Sea; but in the Southern Sea they became very much more scarce.

When they passed from the depth of about 2000 fathoms—he was now only speaking generally—to a depth of 2200 fathoms, they found that these shells at the bottom were becoming, as it were, rotten and yellow. They had not the same clear white appearance which they had in 2000 fathoms and shallower water; and when they went a little further down—say to 2500 fathoms—they found at the bottom none of these shells at all. The deposit which was there forming consisted of a perfectly homogeneous red clay or mud, which, instead of consisting of carbonate of lime, consisted of silicate of alumina—that was to say, the materials of ordinary clay. Now, as a large portion of the bottom of the sea was below 2000 fathoms, a very large portion of the sea—probably by far the greater portion—was being now covered by red clay, and not by these calcareous formations.

The question at once arose,—How was it possible that these calcareous forms, just as abundant on the surface, should stop at a certain point and be replaced by red clay? Whatever might be the reason, there could not be the slightest doubt that when they came to a certain depth the lime was removed, and instead of that they had a red clay.

There was another curious question which arose,—Where did the

red clay come from? The red clay consisted of silicate of alumina. It did not exist as such in any quantity in the shells of the animals which were being dissolved; and there was no doubt that some extremely complicated chymical changes, which were being effected in the sea at this moment, were producing these silicate of alumina and peroxide of iron. Volcanoes, either sub-aerial or marine, either exposed in the air or under the water, were perpetually throwing out material from the crust of the earth, and pumice, which was the froth of the lava, was so light as to float freely on the water. This pumice was found in various stages of decomposition, and, like all other felspathic rocks, it was producing something like clay which they found at the bottom of the sea. So that it was extremely probable that some of this clay might be derived from pumice.

Along with the foraminifera, they had living in the sea a great number of extremely beautiful little organisms, which were known as radiolaria. Instead of these having calcareous shells, they had silicious shells. These silicious shells were sometimes external, sometimes internal, and generally they presented very beautiful forms. Sometimes the sea was discoloured by enormous quantities of these things. In fact, all over the warmer seas they existed everywhere in enormous numbers. The foraminifera of these creatures, which were forming the chalk, appeared to lie mainly on the surface, or a little below it, down, at all events, to 100 fathoms; but Mr. Murray had found, when the tow-net was drawn along a great depth in the sea, that he did not get these forms in the same abundance. Everything seemed to show that they rather belonged to the upper region of the sea.

With regard to the other forms—those of radiolaria—it seemed to be somewhat different, for when the tow-net was dragged along even at the depth of 1000 fathoms, they found that the number rather increased, and that the size of the specimens found at the surface was rather greater. They were inclined to believe that the radiolaria lived all through the sea, down to the greatest depths, something like five miles, and living in that way, although they did not occur probably in such bulk as the foraminifera were themselves, they were adding considerably to the formations which were proceeding at the bottom, and the same causes which dissolved the foraminifera did not dissolve the radiolaria, so that when they had reached the sea at a very great depth, they found those creatures living all through the depth, and dying all through it, and falling to the bottom. They found frequently a formation which had been called radiolarian ooze, on account of its consisting almost entirely of the remains of the radiolaria. There were some other points of very great interest with regard to those accumulations, but the time at his disposal would not allow him to go into them.

In the Southern Sea, where the depth was not so great as in the Pacific or Atlantic, but where the temperature of the surface was very different, they found the surface covered with a set of minute plants, which had a silicious covering, these formed enormous patches over the surface of the sea, colouring it for miles. When the tow-net was drawn through them, it came up full of gelatinous matter of the algæ, perfectly filled with the silicious covering of the cells. These plants were, of course, living and dying on the surface with immense rapidity, propagated excessively, and their remains fell down and formed patches, so that when the trawl was drawn along the bottom of these localities,

it came up with a fine white powder, which looked like chalk. The bottom of the sea was, therefore, composed of the various materials of which he had been speaking, and the nature of the bottom determined to a great extent the distribution of the animals to be found upon it.

Over the whole bottom of the Pacific and the Atlantic, and those portions of the Southern Sea which they had examined, the temperature was usually a little over the freezing point. Down in the valleys it sank to pretty near the freezing point; in a few places, a little below it. On the elevations the temperature was somewhat higher. In the Atlantic they found that from about 500 fathoms to the bottom, the temperature steadily decreased, till it came down to the freezing point, whatever might be the temperature of the atmosphere above, or whatever might be the latitude. The lecturer then adverted to the various currents of the ocean, and their effect upon the temperature. He next spoke of the fauna found at the bottom of the sea. Instead of being barren, the sea contained very wonderful and beautiful fauna. The fauna of the deep sea were somewhat different from those of any of the Polar seas. Certain groups predominated to the sponges, and lower groups were very fairly represented, and, while all the invertebrate groups were represented, these were the most abundant.

V.—GEOLOGICAL RECORDS.

The Geological Formation of the Highlands.—In the Geological Section of the British Association the Duke of Argyll addressed a crowded audience on the geological formation of the Highlands. His Grace refused to accept the extreme views of the glacialists, and with great warmth and vigour combated the views of Professor Tyndall and others. He believed that the Highlands had received their geological formation at a much later time than was generally supposed, and that they belonged to the Miocene period. There were, he contended, proofs of great volcanic action during that era, and there were many evidences of intrusive plutonic matter which must have been exuded at that epoch—in other words, the granite of the Highland hills contains, in his view, evidence of their later origin.

Discussing the glacial theory, while accepting it in a limited degree, and admitting that glaciers had played a great part in the formation of the Highlands, he thought that some limitation should be placed upon it. He did not believe, for instance, that whole continents had been covered with an ice cap, or that glaciers had the power of digging great holes; but he was disposed to suggest "a theory of compromise," and to admit in regard to lake formation that glaciers had made beds for themselves, had deepened existing holes which had probably been formed much earlier, and that glaciers and icebergs had by abrasion left their mark upon the hills, and afterwards formed great lakes.

In support of his theory, the duke pointed to the situation of various boulders, and questioned a variety of geological theories by the application of physical laws. He was inclined also to believe it had a great deal to do with lake formation, and that "terrestrial subsidence" was responsible for more than was usually imagined.

An exciting discussion followed, and his Grace replied at great length. He admitted that the appearance of Ben Lawers proved that it had been under the influence of denudation, but still contended for his theory of subsidence as a general rule.

The Fall of Hill Masses.—The fall of hill masses is a phenomenon not uncommon in Switzerland. The nature of such catastrophes is investigated in a small work recently published by Dr. Baltzer. He distinguishes in every such fall three regions—the place of origin, the course of the rushing mass, and the region of deposition. Most of the phenomena are due to the softening of impermeable marl, clay, or clayey rocks, in whose layers the water stagnates. The mass is gradually loosened and loses its hold. Fissures first arise, as certain pieces of the surface break away before others. When the last attachments are sundered, the mass slides down (like a ship from the stocks) on the slippery underlayer, or tumbles over, breaking into pieces. There are frequently, however, falls of greatly inclined masses, without any softened layer being present. The masses have been saturated with water, which has increased their weight, and they glide down over their solid, rocky foundation, simply in consequence of dissolution and increased weight. Further causes are earthquakes and loosening of the rocks through frost.

The phenomena still, however, present many problems to the geologist and practical engineer. — *English Mechanic.*

In the Jordan Valley.—Professor Porter read a paper before the British Association "On some Points of Interest in the Physical Conformation and Antiquities of the Jordan Valley." The general geological structure of the valley was, he said, of lime, and of the same age as the basin of the Sea of Galilee, and its surface was flat. The breadth varied from three to ten miles, extending a little towards the east, and from the nature of its thick alluvial covering, it was of more recent formation than the mountains, the valley having been at one time apparently a lake, of which the soil was the deposit. The river Jordan, as it at present existed, could have had nothing to do with the formation of the valley itself.

He recommended to the notice of men of science that geological remains on the site of Sodom and Gomorrah pointed to an explosion of bitumen much later than the ordinary geological formation, and probably within the historic period.

Erratic Boulders.—In the Geological Section of the British Association the Rev. H. W. Crosskey presented the report of the committee established for the purpose of recording the position, height above the sea, lithological characters, and origin of the erratic blocks of England, Wales, and Ireland, and reporting matters of interest connected with them.

He directed attention to the distribution of erratic blocks from different centres of ice action, the agencies by which they have been transported, whether by land-ice or icebergs; the different periods in the glacial epoch to which they belong, and the changes in physical geology with which they are associated.

Many erratic blocks of great interest were reported. In Devonshire a block of large size occurred 500 feet above the sea. The erratic blocks of the Midland district contained specimens from the Lake district and Wigtonshire, as well as from Wales, indicating the directions in which the icebergs had travelled. Large boulders, highly striated by ice, had been discovered in excavations near Liverpool, some of them being granite. Between the 400 ft. and 500 ft. contour line in North Cumberland is a boulder from Dumfriesshire, in size 20 ft. by 9 ft., which had travelled forty miles.

Fresh observations had been made in North Wales. The Welsh and the Great Northern drifts had in some districts crossed each other. The direction of glacial strix on the east part of North Wales, as well as near the Avenig Mountains, in general agreed with the course the boulders had taken.

The Density of the Earth's Crust.—The result of pendulum observations carried on in India since 1865, calculated at Kew as far as they have been made with the invariable pendulums of the Royal Society, "offer incontestable evidence in confirmation of the hypothesis of a diminution of density in the strata of the earth's crust which lie under continents and mountains, and an increase of density in the strata under the bed of the ocean; and it is clear that elevations above the mean sea-level are accompanied by an attenuation of the matter of the crust and depressions by consolidation."

Root Marks on Stone.—In the Loan Collection of Scientific Instruments at South Kensington may be seen a slab of marble curiously marked with a series of intricate net-like markings, due to the corrosion exercised by the roots of a plant in contact with the marble. The roots emit carbonic acid, and this, dissolved in water, is capable of at-

tacking the marble. Marble itself, as a simple carbonate of lime, is insoluble, but the bicarbonate formed by the addition of the carbonic acid given out by the root to that already contained in the marble is soluble, and so in proportion to the growth of the plant the marble is marked as above described. M. Meunier, in a recent number of the *Annales Agronomiques*, has described a similar and even more remarkable case in the existence of sandstones (*grès*) consisting of grains of insoluble quartz agglutinated together, and in which the roots have not only sculptured the surface but perforated it. The cause of this is to be sought for in the calcareous cement which joins the quartz grains together. The passage of the roots is rendered more visible by the oxide of iron, which leaves an ochrey stain in the channels traversed by the roots.—*Gardeners' Chronicle.*

The Settle Caves in Yorkshire.—Mr. R. H. Tiddeman, M.A., F.G.S., gave in, at the Glasgow meeting of the British Association, the fourth report of the committee for assisting in the exploration of the Settle Caves (Victoria Cave), Yorkshire. It had been suggested, he said, in former reports that the laminated clay which lay above the hyena bed might possibly be the result of a deposit from glacier water of the time of the ice-sheet, it being now distinctly proved that the animals whose bones occurred in the bed beneath it existed in that district at a time prior to that cold period. Discovered facts implied that the animals whose remains were found in the lowest known bone beds in the Victoria Cave lived in this country in a well-marked interval between two periods of extreme cold, of which the first was the most extensive in its effects. It was therefore within the limits of possibility, if not of probability, that this lower thickness of laminated clay was a representative in time of the earlier glacier beds of the south-east of England. "In our last report,' said the committee, "we called attention to the existence in the Victoria Cave of a fauna, which we may confidently assign to a cold climate, separated in some parts by an accumulation of deposits, 12 ft. in thickness, from an earlier one which is equally characteristic of high temperatures, whereas, in another part of the cave far off, where the material to separate them is wanting, we have animals from icy and tropical countries intermingled in a confusion which would be puzzling did we not get the clue hard by. We remarked that it was evident that the separation was natural and regular, the mixture abnormal and accidental. The excavations still throw light upon how the cave was formed. As far as we have yet worked at the present level, the right wall of the cave is seen to have been hollowed out by streams. Several grooves occur indicating watersheds, but except quite at the entrance we have not yet got down to the ancient floor. We are already working in deposits which are older, probably, than the older Thames gravels."

The Exploration of Kent's Cavern.—Mr. Pengelly gave his report, at the Glasgow meeting of the British Association, on the year's work upon the explorations of Kent's Cavern. He mentioned the precautions he had been obliged to take to secure himself against the tricks of travellers. He exhibited two sides of the upper jaw of the hyena, bones of the bear, the fox, the rhinoceros, as well as gnawed bones. In the same stratum were found a flint implement and two chips, proving that man lived in this country in prehistoric times. In the oldest deposit there were the remains of a bear, some of the teeth of which were worn down to a stump. Bearing out Mr. Pengelly's researches, Mr. Tidde-

man, the explorer of the Settle Caves in Yorkshire, announced that animal remains of the hyena, the bear, and the rhinoceros had been found, as well as the fibula of a man, lying in such a way as to leave little doubt that the two had been co-existent. Bears, he explained, were very plentiful, and goats appear to have been exceedingly early inhabitants of Britain.

Ocean Deposits and their Origin.—Mr. John Murray gave an address before the British Association on oceanic deposits and their origin, based on observations on board the *Challenger*. He described and exhibited specimens of various kinds of deep-sea deposits. He did not think the detritus of the modern land was carried more than two or three hundred miles from the shore. A novel constituent of the deepest sea-bottoms was pumice dust, which had been found in almost every region, arising from submarine volcanic action. Mr. Murray thought he had never failed to find a piece of pumice, when it was carefully looked for in any of the dredgings, and he believed it to be the chief origin of the deep-sea clays.

Another element which appeared to have been detected at great depths was "cosmic dust," or dust formed from aërolites. Another interesting point was that whenever they got into deep water, they found manganese peroxide in nodules inclosing organic remains—sharks' teeth and pieces of bone. This formation seemed to be connected with the disintegration of volcanic rocks.

Mr. Murray also discussed the question whether true equivalents of the deep-sea deposits now made known were to be found in the series of stratified rocks. If this were not the case, then it must be held that the great continents had remained substantially the same throughout a vast length of time.

Stores of Water Underground.—The following constitutes the "Second Report of the Committee on Underground Waters of the New Red and Permian Formations of England," delivered to the Glasgow meeting of the British Association:—

The committee's inquiries have been continued last year, particularly with reference to Liverpool, Birkenhead, Nottingham, and Birmingham. Information has also been promised from Staffordshire. The committee hope to complete their labours before next meeting of the Association.

Statistics were given by Mr. de Rance regarding the amount of water obtained from wells at Liverpool, Coventry, Birmingham, Leamington, Nottingham, Birkenhead, Warrington, and Stockport. It was mentioned that at Liverpool the level of the water in the public wells is gradually being lowered.

At Barrow-in-Furness a bore for coal 3210 feet deep struck, at the depth of 250 feet, a spring which now yields 13,500 gallons daily, and rises 12 feet above the surface. In this case, as had been predicted by Mr. Aveline, a member of the committee, the Permian rocks were found directly overlying the Millstone Grit, and it was thus proved that the Coal Measures lying to the north are not continuous beneath the Permian. Another important circumstance discovered by this bore was the existence of petroleum in the Millstone Grit.

The New Red Sandstone, being porous and ferruginous, has been found to filter the water and oxidise the organic matter contained in it. Water from wells in the New Red, even when not artificially filtered, ranks high among drinking waters for purity and wholesomeness, containing little saline and hardly any organic matter.

Taking an average rainfall of 30 inches per annum, and granting that

only ten inches percolate into the rock, the supply of water stored up by the Permian and New Red formations was estimated by the committee to amount to 140,800,000 gallons per square mile. This rate would give, for the 10,000 square miles covered by the formations, 1,408,000,000,000 gallons. Only a very small proportion of this amount is made available for the supply of cities and towns.

The Sub-Wealden Boring.—A paper from Mr. Willett upon the Sub-Wealden boring was read at the Glasgow meeting of the British Association. He advocated the abandonment of the undertaking, believing that no further information of sufficient value to justify the expense could be expected from the present boring.

Major Beaumont, M.P., followed the reading of this paper, with a paper on the other side, urging that the exploration should be continued. Mr. W. Topley, who had been deputed by the Government Geological Survey to superintend the boring, gave an outline of the history of the question, and stated the results already attained. He said, if it were now a question of beginning again from the surface, he would advocate the selection of a site near Hythe; but since a depth of nearly 2000 ft. had now been attained, he thought it might be as well, if possible, to continue the present hole. Sir J. Hawkshaw said he hoped that the present boring could be continued; and Captain Douglas Galton stated that a grant of 100*l*. had been voted by the Association.

Professors Young, Hull, Seeley, Mr. Lebour, and others spoke, all urging that the boring be continued. General regret was expressed that Mr. Willett had resigned.

Earthquakes in Scotland.—A paper on the earthquake districts of Scotland was read before the British Association by Dr. James Bryce, F.G.S. Dr. Bryce observed that there are two lines along which earthquakes are commonly observed, the one running from Inverness through the North of Ireland, to Galway Bay, and the other passing east and west through Comrie. The phenomena of earthquakes in the latter district are now being systematically observed and recorded, under the direction of a committee appointed by the British Association, seismometers being employed on the two principles of vertical pendulums and delicately poised cylinders. Arrangements have been made to ascertain whether shocks in this region can be traced to any common central point, there being reason to believe them to be connected with a mass of granite in Glen Lednoch, whose position was indicated on a map exhibited by the author.

The existence in the vicinity of Comrie of important lines of fracture in the earth's crust was pointed out, and it was suggested that these might be records of earthquakes in remote geological times. One of these lines of fracture is filled up with a dyke of basaltic rock, traceable from the Melville Monument, near Comrie, to Loch Lubnaig, and belonging to the series of dykes now regarded as of Miocene age. The other line of fracture is much older, and divides (with an enormous displacement) the Lower Old Red formation from the Metamorphic rocks of the highlands.

For the Comrie earthquakes, Dr. Bryce was inclined to accept Mr. Mallet's explanation, viz., the shock produced by the fall of masses of rock from the roof of some subterranean cavity.

As a remarkable manifestation of earthquake activity, Dr. Bryce alluded to a sudden rise of 2½ feet in the level of Loch Earn, described in a former report of the Earthquake Committee. On that occasion no

change in the atmospheric pressure was indicated by the barometer. It was several hours before the motion of the lake's surface subsided.

Winged Reptiles.—Numerous examples of the winged reptiles, known as Pterodactyles, have been found in the cretaceous rocks of Western Kanzas. Professor O. C. March has discovered among them certain forms which present characteristics that widely separate them from all previously known fossils. Hence he proposes to establish a new order of Pterodactyles, under the name of Pteranodontidæ, a name suggested by the fact that the reptiles of this new type were destitute of teeth. It is notable that they occur associated with Marsh's interesting birds with teeth, or Odontornithes.

No Friend to Geology.—M. Victor de Bonald, a French author, has just written a work entitled "Moses and Modern Geology." The author is strenuously opposed to modern progress, and condemns the introduction of geology into Christian schools. A correspondent of the *Pall Mall Gazette* says M. Victor de Bonald is an author of "considerable merit." He seems, however, to have his weak side. Alluding to the motion of the earth as described by Copernicus, he says :—"Thus the angels in heaven contemplate in the midst of the works of the creation that which is the masterpiece and the king; not in the grave and majestic attitude of a prince in the middle of his subjects, but turning head over heels and pirouetting about in space in presence of the sun and immovable stars." M. Victor de Bonald questions the discoveries of Copernicus, Galileo, and Newton.

VI.—METEOROLOGY.

The Winter of 1875-76.—The lowest temperature registered in what is technically called the "winter" of 1875-76 in the fifty places in England and Wales, included in Mr. Glaisher's report to the Registrar-General on the weather, was 10°, which minimum was recorded in January last at Beckenham, Kent, and also at Lampeter, Cardiganshire. It will be of interest to note the lowest temperature recorded in the course of the winter at such watering-places as are in the list. The lowest registered by the Rev. Mr. Quelch at St. Augustine's Monastery, Ramsgate, was 23·5°; by Mr. J. R. Mann, at Osborne, 22·8°; by Mr. F. E. Sawyer, at Brighton, 22·6°; by Dr. Compton, at South Bourne, near Bournemouth, 22·2°; by Dr. Nicol and Dr. Dalton, at Llandudno, 22·2°; by Mr. A. E. Murray, at Hastings, 20·9°; and by Miss W. L. Hall, at Eastbourne, 17°. At Eastbourne and South Bourne the greatest cold was in December, but in most places it was in January.

Cannonading the Sky.—An interesting lecture was delivered the other day at Lexington, Kentucky, by Mr. Woolfolk, pastor of the First Baptist Church of that place, in which he maintained that the terrestrial climate is made subject to the control of man to such a degree that the winters of the north temperate zone may be rendered as mild as the vernal season. He also affirmed that the Arctic Ocean may be broken up, and the dreary basin made the pathway of commerce! Mr. Woolfolk, who is stated to be "a man of ability (!) devoted to scientific studies all his life," and to "stand in public estimation without a blot," proposes to cannonade the sky with the view of effecting favourable changes in the weather and temperature. After the lecture he was "interviewed" by a reporter of the New York *Herald*, to whom he gave a synopsis of his theory; which, stated briefly, is to the effect that cannonading is the most effectual method of breaking the cold polar waves, and introducing tropical warmth to the north temperate zone. Mr. Woolfolk is of opinion that the Pacific Ocean is specially adapted for a storm track, and proposes to erect batteries on the most western of the Aleutian Islands to produce the desired result. As he stated to the reporter, "by keeping the storm track open, the tropical current would drift towards it, the southerly wind would constantly sweep the Atlantic, driving before it the warm surface waters of the Atlantic into the Arctic basin, and out through Behring's Strait into the Pacific. The rush of tropical winds and the drift of tropical waters would produce great changes in the Arctic regions. Under their genial influence ice and snow would soon disappear."—*World of Science.*

Rain enough for Everybody.—A fall of rain of one inch in depth sends down 100 tons of water on an acre of ground. One hundred tons of water is ample for the utmost requirements of two persons for a year. The proportion of population to area over the whole United Kingdom gives 2½ acres to each person; so that the fall of a fifth of an inch of rain, if it were all utilised for the purpose, would be

sufficient for the supply of the people on an allowance equal to that of the best watered towns. The mean average rainfall of the kingdom is not accurately known, as numerous districts are as yet without recorded observations. As far as is yet ascertained, it may be roughly stated at about 36 inches per annum, or 180 times the quantity of water required for human consumption.

An Electrical Rain Gauge.— In *La Nature* for the 8th January, a new rain-gauge was described, which is the invention of M. Hervé Mangon, and is in action at his observatory at Ste. Marie-du-Mont. The rain is caught in a funnel, and conveyed to a cylinder, in which there is a float moving between guides. This float is connected with a pencil, which marks its height by a continuous line. The time is marked by an electro-magnet, which is set in action at regular intervals by a clock. The record is taken on a paper stretched between two cylinders, also moved by the clock, and the scale is so chosen as to enable the same paper to take a rainfall of one metre for a year, which suffices for most of France.—*Academy.*

The Rainfall of 1875.— Mr. Symons, secretary of the Rainfall Committee, read their report to Section G. of the British Association at Glasgow, for the past year. It appeared that the rainfall of 1874 was slightly below the average, owing to a rather dry spring and exceedingly dry summer. The most remarkable feature of the year was the heavy fall of rain on October 6, when the average fall over England and Wales was slightly above one inch in the twenty-four hours, and the fall at most stations in North Wales and the Lake district was upwards of five inches. So heavy a fall over so large an area was rare.

The rainfall of 1875 was greatly above the average in England (especially in the midland counties), and irregular in Scotland and Ireland. A very heavy rainfall occurred in Wales and southern England on July 14, the fall in twenty-four hours exceeding one inch at 252 stations, two inches at 109, three inches at thirty-nine, four inches at seven, and five inches at three stations.

The committee reported last year the success of their efforts to improve the geographical distribution of rainfall stations in Ireland, showed that the gauges started at the cost of the Association, had been supplemented by many others, established at the cost of private individuals, and gave a map showing the present complete distribution of stations. Almost all the observers have proved good ones, and the returns had been forwarded with regularity. The period was too short to yield precise results, but a good system had been inaugurated, and was in full operation. The committee felt they had done service to rainfall work. When they commenced their labours, the weakest part of rainfall observations was the defective geographical distribution of the stations. This defect had now been materially lessened. By the grants of the Association nearly 250 gauges had been erected in districts hitherto without observations.

After the reading of this report, Mr. Bramwell asked what the committee meant to do in the future. Mr. Symons said he understood the Association wished to discontinue its grant to the committee, and that the connection between the two should now cease. This he very much regretted, because if anything happened to himself he did not see how the work of the past could be maintained. Mr. Symons added that we had now in this country a system of observations which was the admiration of all countries. America and other countries were copying us. The system now embraced something like 2000 stations,

so scattered that it was scarcely possible to drop a man down in any place where he would be more than four or five miles from a rain-gauge. The consequence was, that when hydraulic and waterworks questions turned up, data were almost always available, which did not exist ten years ago, for ascertaining the quantity of water which could be collected from any given gathering ground. With reference to the future maintenance of the system, it simply rested with himself.

It was ultimately stated by the president that the sectional committee considered the time had now arrived when this work should be taken up in a larger public spirit, and consequently that the grant hitherto made should now cease. This recommendation was made in the confident expectation that those who had hitherto so greatly benefited by the laborious and successful work carried on by Mr. J. S. Symons for the Association, would come forward and make the work of the Rainfall Committee their own.

Spots on the Sun and Storms on the Earth.—The Spanish *Industrial Gazette* says it is certain that the sun plays the chief part in the meteorological phenomena of our planet. Though we cannot easily understand how its spots can influence our atmosphere; though, even when largest and most numerous, they cover a comparatively small part of its disc; though we do not know whether they are outbreaks of heat or tendencies to coolness, or whether they operate by way of heat or electricity, or in any other way, nevertheless appearances go on developing and multiplying effects which seem dependent on the periodicity of the spots.

M. Bezold, a philosopher of Munich, has recently devoted himself to a special study of the storm period, chiefly availing himself of the documents collected in Bavaria. The first fact which claims attention is that, if a certain period of years is examined, the number of storms goes on increasing or decreasing, but these variations are periodic.

If we inquire what are the meteorological causes that can be in relation with storms, the first that presents itself is heat. M. Bezold constructed a curve of the mean temperatures of each year, and compared it with that of the sun's spots. Afterwards he compared the two curves with that of the annual number of storms, and found that the minimum of storms exactly coincided with the maximum of solar spots. On the other hand, the curve of storms forms in some measure the middle term between that of the sun's spots and that of the deviations of temperature from the mean temperature of southern European latitudes.

It is observable that the course of storms shows a general and undoubted relation to that of the curve of solar spots, so that, *e.g.*, from 1775 to 1822, the maxima of the first exactly correspond with the minima of the second. Nevertheless, the details of the curve of storms agree better with those of the curve of temperature, and nearly every elevation or depression of the latter may be traced in the former. This relation between storms and the deviations of annual temperatures from the general mean temperature is manifest, even when that between storms and the sun's spots is less evident.

The general result may be thus stated. High temperatures, as well as an absence of spots from the sun's disc, produce a greater number of storms during the year than the opposite of these conditions. On the other hand, supposing the maximum of solar spots coincides with the intensity of the aurora borealis, it follows that the two forms of electric phenomena are complemen-

tary, and that in the years in which there are many storms there are few auroræ boreales, and vice versâ. It is not proved that this is the result of a direct electric influence between the sun and the earth, because these effects may depend upon the intensity of the heat which emanates from the sun. It would be well to have similar comparisons made in other latitudes.—*English Mechanic.*

The Climate of Scarborough.—A paper "On the Climate of Scarborough," was read before the Meteorological Society, on the 21st of June, by Mr. F. Shaw. The thermometers used were placed in a louvre-boarded case, fixed to the north side of a wooden structure, having an open grass plot in front of them. The garden is about midway between the north and south sides of the town, and 150 yards from the shore; and as both residents and visitors are continually passing along this line, the observations may be taken as fairly representing the temperature of Scarborough as a watering-place. The mean monthly temperatures, based on the average of the past eight years, are, January, 38·8°; February, 39·7°; March, 41·6°; April, 46·6°; May, 50·5°; June, 55·9°; July, 60·4°; August, 58·9°; September, 55·1°; October, 48·2°; November, 42·2°; December, 39·0°. The mean for the year, 48·1°. The maximum temperature on any day in July, the warmest month, does not exceed on the average 78·0°, the highest in the eight years being 85·5° in 1868. The mean of the extreme minimum temperature in the eight Januarys is 24·2°; the lowest being 13·3°, which occurred on January 1st, 1875. The annual rainfall, on the average of the past ten years, is 28·29 inches, which falls on 167 days.—*Athenæum.*

The Barometer in Winter and Summer.—Professor Mohn has published some remarks in the Austrian *Journal for Meteorology*, on the reason why barometrical depressions are, as a rule, more serious in winter than in summer. He cites the opinion of Buchan and Wojeikoff that, as the air is shown to ascend over such areas, and to descend over areas of barometrical elevation (anticyclones), it is clear that in the upper regions of the atmosphere the conditions of pressure must be reversed as compared with those at the surface of the earth. In other words, over an area of low pressure, a cyclone, there must be an excess of pressure at a certain level causing an outflow of the air which is rising. Conversely, over an anticyclone there must be a defect of pressure at a certain height, which has the tendency to attract the air towards the region of its existence.

These principles being once admitted, it is evident that as the contrast in temperature between land and sea in these latitudes is greatest in winter, the conditions then prevailing will be most favourable to the production of extensive depressions over the heated area, the sea, while in summer the conditions are reversed, and the areas of low pressure appear over the land. Prof. Mohn seeks to explain the origin of the well-known deficiency of pressure in the South Polar regions on the above principles. He concludes with pointing out the obvious moral of his remarks, to the effect that for a satisfactory study of weather by means of telegraphic reports, the area of observation should be as extensive as possible.

Firedamp and the Barometer.—The decrease of atmospheric pressure which unlooses the spirit of the winds above ground, and thereby occasions a great amount of loss and damage on land and sea, is no less a source of peril to the miners, who work like the moles underground. The damage in coal-mines consequent especially

on the sudden fall of the mercury in the barometer tube, is occasioned in this wise. When the glass is high, and the pressure of the superincumbent atmosphere correspondingly great, the dangerous carburetted hydrogen is prevented from issuing from the walls and sides of the coal-seam; when the pressure is suddenly lessened, the gas escapes from numberless chinks and crannies, and accumulating, sometimes very rapidly, until it reaches the proportion sufficient with common air to produce an explosive compound, the naked light that is harmless under more favourable conditions suddenly takes effect, and a deadly catastrophe is the result. In this way the barometer and barometric warnings are almost as useful to the coal-miner as they are to the mariner and fisherman.—*Iron.*

The Physical Explanation of the Mackerel Sky.—Sir Wm. Thomson read a paper before the British Association on the "Physical Explanation of the Mackerel Sky." He explained the relation of the clouds and their movements, and remarked that it was not essential to the formation of a mackerel sky that there should be two different temperatures. All that was essential was that portions of air should be moving up and down; and further, that the up and down motion should seem as though it resulted from the slipping of one stratum of air upon another and the production thereby of waves; and the second essential was, that one or other of the two portions of air should be very near the point of saturation—that it would be clear when down at its lowest point, and cloudy when up at its highest.

Professor Andrews said he had had great pleasure in listening to Sir Wm. Thomson, for that was a subject in which he had himself been interested for the last ten years. He was happy to hear it so well explained, as the subject was one of enormous difficulty. He had been given to understand that a mackerel sky was an indication of fine weather, and that the primary cloud formation was the reverse.

M. Glaisher said he had heard it said that there were no flat-bottomed clouds; but upon one occasion, when up in a balloon to the height of 2400 feet, he passed through a cloud which was decidedly flat-bottomed. The dry east wind was acting on the lower part like a knife, making it flat. On other occasions, at whatever height he was, when he passed from a low temperature to a higher, he was always sure to find the flat-bottomed clouds.

Celestial Influences.—M. Janssen, having arranged large photographing telescopes at his house at Montmartre, has found that, from the beginning of May up to the 10th, when the weather was very cold, the sun had no spots at all.

The Importance of Peat Beds.—The *New York Tribune* says:—In some remarks on the climatology of New Hampshire, Professor Huntington states that the preservation of the vegetation on our mountains is of great importance, not only in modifying the distribution of rain, but also in modifying the extreme of cold in winter. Our mountains, especially the higher summits, are covered to a considerable depth, except where it has been destroyed by fires, by peat, formed chiefly from moss and lichens. Now it has been found by experiment that peat moss can absorb more than twice its own weight of water; dry clay, nearly its own weight; dry earth or garden mould, more than half its own weight; and dry sand a little more than a third of its own weight. With equal times of drying, under the same circumstances, therefore, peat moss loses two-thirds of all the water it

contained; clay and earth, more than three-fourths; and sand, more than nine-tenths. Thus, in a dry season beds of peat must form an invaluable reservoir of water for the supply of springs and streams. Wherever it or vegetable mould abounds the soil retains its moisture, being only gradually evaporated, a high relative humidity is maintained, and springs gush forth from the slopes of the mountains, and a slight change in the temperature causes rain to fall in gentle showers. It is noted that on the mountains of New Hampshire fires in general spread only over their eastern slopes.

Thunderstorms in Germany.—The phenomena of thunderstorms in Germany have been studied by M. Gustav Hellmann. He finds that the mean annual number of storms increases, in general, from N.E. to S.W. On the shores of the Baltic it is least, in the upper Rhine region greatest (Memel 9, Darmstadt 30). The influence of height above the sea level appears in the fact that the number of storms increases up to a height of 1300 to 1400 m., then quickly decreases. The maximum of frequency of storms is in the three summer months, June, July, August; but there is a difference here, between west and east; for (with exception of the coasts) the greatest number of storms occurs in Eastern North Germany in June; in Western in July; the direction Stettin, Berlin, Torgau, forms the partition line of the two regions. Winter thunderstorms are wholly absent from the coast of Prussia, and in January and February also from the interior. Their number is greatest on the North Sea coast and the adjoining lands, Hanover and Oldenburg. For the rest the number of winter storms decreases, in general, from north to south. — *Zeitschrift für Meteorologie.*

Intercrossing Rainbows. — An extremely rare phenomenon, that of intercrossing rainbows, was observed by M. Gumœlius in a valley in Sweden, on an evening in June, 1875 (*Archives des Sciences*, Oct. 15). Two ordinary semicircular rainbows were seen as if resting on the hillside, their centre about the middle of the valley. The crossing arcs extended from the base of the interior bow to about 45° up the exterior bow, and their centre seemed to be about the top of the interior bow. In these crossing arcs the columns were arranged as in the interior bow, the red without, the violet within. These unusual bows are generally explained by the reflection of the image of the sun from a surface of water situated behind the observer; and M. Rubensen (who commented on the phenomenon to the Stockholm Academy) notes the presence of a sheet of water a little to the north-west, but finds some difficulty as to the position of the bows. A curious solar halo is described in a recent number of *Les Mondes.* These were two broad rings, the outer coloured, subtending 40°, and about double the diameter of the inner one, which was white. In addition, a larger blue circle was observed passing through the sun, its diameter N.E. and S.W. —*English Mechanic.*

Red Snow near London.—On Sunday the 12th of March, 1876, at Forest Hill, near the Crystal Palace, red snow was found. This red snow resembled nothing so much as strawberry ice, and when melted left a red deposit, which under an ordinary microscope looked like vegetable cells—at least so says a writer who had an opportunity of examining it.

Ozone in the Atmosphere.—M. Losecke has recently made some interesting experiments in order to ascertain the amount of ozone present in the atmosphere at different periods of the year. The greatest

amount was observed in February, and the least in November, the quantity present during the months from April to October remaining nearly constant. In a courtyard the indications were usually lower than in a garden, yet the quantity present in a room remained the same, whether the windows were open or shut. No connection was traceable between wind or moisture and the ozone indications, and thunderstorms appeared to produce no visible alteration.

The Direction of Cirrus Clouds.—The movement of the cirrus clouds has been made the subject of study by Hildebrandsson of Upsala, who hopes thereby to deduce some results relative to the ascending and descending movements of the atmosphere above the regions of high and low barometer. The observations of Clement Ley show that the cirrus clouds move from areas of minimum towards areas of maximum pressure, and Hildebrandsson has endeavoured to extend this interesting generalisation over a wider field. He states, in fact, that a general study of the clouds over the whole of Europe shows him that while the air on the earth's surface moves in spiral curves, inward, toward low barometer, the air at a high altitude simultaneously moves outward. The principal winds, therefore, constantly make an angle toward the right, with the lower winds. This determination was long ago made by Abbe for the United States, and may probably now be considered as a general rule, applicable throughout the world. It is important to notice that the same conclusion was arrived at deductively by Ferrel in 1857, and is fairly stated in his great work on the motions of bodies on the earth's surface.

Our Daily Supply of Heat.—It has been shown, by the researches of Sir John Herschel and Pouillet, that on the average our earth receives, each day, a supply of heat competent to heat an ocean 260 yards deep over the whole surface of the earth, from the temperature of melting ice to the boiling point. Now, on or about June 30, the supply is about one-thirtieth greater. Accordingly, on June 30, the heat received on a single day would be competent to raise an ocean $251\frac{1}{3}$ yards deep from the freezing to the boiling point; whereas on December 30, the heat received from the sun would so heat an ocean $268\frac{2}{3}$ yards deep. The mere excess of heat, therefore, on December 30, as compared with June 30, would suffice to raise an ocean more than 17 yards deep, and covering the whole earth, from the freezing point to the temperature of boiling water!

Dalton's Law, and the Constitution of the Atmosphere.—It is well known that the famous law of Dalton, with reference to the diffusion and independent existence of aqueous vapour in the atmosphere, has exerted a very strong influence in moulding the views of meteorologists as to the method by which this portion of the atmosphere operates in modifying atmospherical phenomena. Of late years, however, very strong suspicions have existed as to the propriety of carrying Dalton's views to the extreme that has been maintained by many. In fact, so early as 1840, Espy distinctly controverted them. Of late, Hildebrandssen, Hann, and especially Stefan have more correctly explained the limitations within which Dalton's laws may be applied. According to the latter, these obtain in the case of a mixture of gases, only under conditions of static equilibrium, and do not hold when these are in motion. Since the vapour of water in the air, in consequence of its continual evaporation and condensation, is always

in movement, it does not conform to Dalton's laws. The permanent gases of the atmosphere, especially oxygen and nitrogen, which retain in general the same proportions, are in equilibrium, and do form atmospheres independent of each other, according to Dalton's laws. It necessarily follows that the percentage of dense oxygen must be smaller as we ascend in the air; and, in fact, chemical analysis gives this result. The limits of the application of Dalton's laws, it will thus be seen, like many another scientific subject, have not yet been clearly defined.

In the Neighbourhood of the Suez Canal.—As an interesting result accruing from the Suez Canal, M. de Lesseps mentions that it has increased the rainfall in the surrounding country to a remarkable extent. Previous to 1870, rain only fell about once a year; now it falls at least twice a month.

VII.—HEAT.

The Sun's Heat utilised for Industrial Purposes.—M. Mouchot, who has devoted the last fifteen years to the study of this question, thus arranges his solar receiver or generator. It consists of three distinct parts :—A metallic mirror with linear hearth ; a blackened boiler, the centre line of which coincides with this hearth; and a glass casing which allows the solar rays to impinge upon the boiler, but prevents their being reflected. The mirror is in the form of a truncated cone, the generating line of which makes with the axis an angle of 45°. The base consists of a disc of cast-iron, added for the purpose of counteracting the effect of the wind. In the centre of the disc rises the boiler, the height being equal to that of the mirror; it is made of copper, blackened on the outside, and is composed of two concentric casings, the larger of which is 80 centimetres (2 ft. 7½ in.) high, and one smaller, 50 centimetres (1 ft. 7½ in.), the respective diameters being 28 and 22 centimetres (11 and 8½ in.). The feed-water occupies the annular space between the two casings. The volume of liquid should not much exceed 20 litres (4½ gals.), so as to leave about 10 litres for the steam chamber. The glass casing is bell-shaped, 85 centimetres high by 40 in diameter (2 ft. 9½ in. by 1 ft. 3¾ in.), and 5 millimetres (0·19 in.), thick. There is, therefore, a constant space of 5 centimetres (2 in.) between the boiler and the glass, which latter only adheres by its foot or rim to the bottom of the mirror. Thus arranged, the boiler should revolve, at the rate of 15 degrees in an hour, on an axis parallel to that of the earth, and also becomes gradually inclined on this axis, the inclination being in accordance with the declension of the sun.

The following are the results achieved by the apparatus at Touraine. In ordinary fine weather, 20 litres (4½ gals.) of water introduced at 20° Centrigade (68° F.) at half-past eight o'clock, were turned into steam at a pressure of two atmospheres in forty minutes. The pressure was then quickly raised to five atmospheres, a limit which it would have been dangerous to exceed in the boiler with which the experiment was being conducted. The steam was used to drive an engine working a pump, &c. ; it also distilled 5 litres (a gallon) of wine in a quarter of an hour. It may be concluded, from the trial, that in our latitudes, the apparatus utilises from 8 to 10 *calorics* (32 to 40 English equivalents of heat) per square metre (1·19 square yards) per minute. —*Journal of the Society of Arts.*

VIII.—LIGHT AND VISION.

Coloured Lights. — Experiments have been recently made at Trieste, says a contemporary, for the purpose of determining how far different coloured lights penetrate darkness. Six lanterns, with carefully selected glass of different colours, and furnished with wicks and oils of good quality, were lighted on the beach, and observations were made by a party in a boat. At the distance of half a league the light-blue lantern was invisible. At the same distance the dark-blue lantern was scarcely visible. The white lantern was seen at the greatest distance of them all. The red lantern was seen at the second and the green lantern at the third greatest distance. White, red, and green lights have the greatest power of penetrating darkness. Red and green lights are particularly recommended for lighthouses and for signals. Green light has one peculiarity, at a short distance it begins to look blue, and often deceives persons. For this reason they who made the experiment suggest that, as a signal, a green light should never be used except in conjunction with red and white lights.

A new form of Kaleidoscope. —An improved form of kaleidoscope by M. Thomas, of Paris, has been reported on favourably by the *Société d'Encouragement.* The two mirrors are, as usual, placed in a tube, but the objects employed to produce the images are inclosed in a transparent case, which is separate from the tube. This case, almost flat, and with its two faces formed of watch glasses, is supported by a rod which is fixed to the tube by a hinge; it can also receive a movement of rotation round its axis of suspension. In this way it can be inclined in any direction to the axis of the tube. A button manipulated with the hand enables one to turn it about its centre, so as to change the positions of the objects within. A pasteboard disc, white on one side, black on the other, is placed behind the case. Transparent or opaque objects may thus receive light on one or the other side of the case, and be detached on the white or black background of the disc, according as it may be desired to observe them by transmission or by reflection. M. Thomas has obtained much more beautiful effects by this new method, and of infinite variety. The instrument is recommended to artists, designers, and others.—*English Mechanic.*

An Optical Experiment. — Professor F. E. Nipher suggests the following optical experiment: observe a white cloud through a plate of red glass with one eye, and through green glass with the other. After some moments transfer both eyes to the red glass, opening and closing each eye alternately. The strengthening of the red colour in the eye, fatigued by its complementary green, is very striking.

Light and Electricity. — A curious discovery has followed Mr. Crookes's discovery of the dynamic power of light. It is this,—that selenium, a metal or metalloid which, under certain peculiar treatment, acquires a very feeble power, even when kept in the dark, of transmitting the electric current, is made, by exposure to light, a conducting medium for the electric current far less inadequate, far more perfect than before. So that a very poor conductor of electricity becomes a good conductor of electricity under

the influence of light. In other words, we suppose, a new dynamic effect of light—one exerted especially on the molecular structure of selenium—has really been discovered. Possibly, in the same way, light may be found to stimulate the conducting-power of the nerves. It is not a matter to have an opinion upon without exact measurements, but we (*Spectator*) fancy at least that some of our nerves appear to carry messages much more rapidly when exposed to light than they do in the dark.

Our Sensations.—The notion of persistence of luminous sensation arises from the optical effect produced by rapid rotation of some lighted body. M. Lalanne recently made analogous experiments with tactile sensation. Suppose a flexible body, which will not injure the skin by motion in contact with it, rotated rapidly round the arm or leg held steady. If the return of the body to each point of contact take place in a sufficiently short interval, equal to the duration of the impression produced, then (analogously) a continuous sensation should be experienced, like that produced by pressure of a bracelet or ring. M. Lalanne finds, from thirty-three experiments on various parts of the body: (1), that the continuity is never manifested for less than ten turns per second (showing that the duration of tactile sensation observed did not exceed 1-10th of a second); (2), the least duration observed was 1-24th to 1-25th of a second; (3), this minimum of duration varies in individuals, and according to the parts of the body. The duration of tactile sensation, then, seems to be little different from that of luminous sensations. And acoustic sensations present facts of the same order.

The Influence of Residual Gas on the Movement of the Radiometer.—Mr. W. Crookes, at the Glasgow meeting of the British Association, entered into an explanation of the above subject, and referred to an instrument exhibited by him at the soirée of the Royal Society on 5th April, 1876, which proved the presence of residual gas in a radiometer which had been exhausted to a very high point of sensitiveness. This instrument proved that, at a rarefaction so high that the residual gas was a non-conductor of an induction current, there was enough matter present to produce motion, and therefore to offer resistance to motion. That this residual gas was something more than an accidental accompaniment of the phenomena was rendered probable by the observations of Dr. Schuster, as well as by his own experiments on the movement of the floating glass case of a radiometer when the arms were fixed by a magnet.

The Action of Light on Artist's Colours.—A paper, read at Edinburgh by Mr. R. H. Bow, regarding the action of light upon pigments employed in painting, touches upon a subject which has worried artists a great deal recently. Indeed it was for the purpose of teaching painters something about the pigments they employ that the Royal Academicians decided upon the appointment, some time ago, of a professor of chemistry, and lately lectures have been regularly delivered to students on the composition of the colours they employ.

Mr. Bow tells us that his experiments have led him to the conclusion that Prussian blue in oil is the most stable of colours; but it does not follow for this reason that it the most suitable for painters. Most artists are aware that the light will act upon the majority of their pigments after a time, and for this reason they not unfrequently produce more vivid effects at first, as they are quite sure that after a few years these will become softened

down by the bleaching action of the light. As their canvas is sure to fade in some parts, let them take what care they like, it is the best policy for them to employ oil pigments, possessing as much as possible the same photographic properties, so that they may alter in something like the same degree.

A picture seldom loses much of its beauty by becoming of a lower tone than when first painted, provided the change that comes over it is not too marked. It would never do, for instance, to employ the fleeting aniline pigments upon the same canvas with the stable Prussian blue, painting one portion of a picture with the former and another with the latter. In fact, the aniline colours are for the most part quite unsuited for painting purposes, and some of them are so changeable in the sunlight that they have been used for the production of photographic images. Again, they are extensively employed—especially in Germany—for colouring photographs, their thin transparent character rendering them particularly suitable for the purpose, for it is possible to see the shadows and outlines of the image beneath the layer of colour; but photographs tinted in this way soon lose their bloom, and the colours are often seen fading while the pictures are yet exposed for sale in the shop windows.

There are very few pigments indeed which are not acted upon by light to some degree, and for this reason it is that pigment or carbon prints are said not to be permanent; but there are, at the same time, many colours known to chemists and artists which are sufficiently stable for practical purposes. Indeed, if we push the matter far enough, we may well ask if anything exists on earth that is proof against the continued action of the sun's rays, and whether the words permanent and unalterable, as applied to worldly matters, is not altogether a misnomer.—*Photographic News.*

Metallic Reflection: an important discovery.—Prof. G. Stokes read a paper before the British Association on "A Phenomenon of Metallic Reflection," in which he gave an account of a phenomenon observed by him many years ago, and which was in some respects very remarkable. He explained that when Newton's rings were formed between a lens and a plate of metal, and were viewed by light polarised perpendicularly to the plane of incidence, it was known that, as the angle of incidence was increased, the rings, which were at first dark-centred, disappeared in passing the polarising angle of the glass, and then reappeared white-centred, in which state they remained until they could no longer be followed. At a high incidence the first dark ring was much the most conspicuous. To follow the rings beyond the limit of total internal reflection a prism must be employed. When the rings formed between glass and glass were viewed in this way, as the angle of incidence was increased the rings one by one opened out, uniting with bands of the same respective orders which were seen beneath the limit of total internal reflection; the limit or boundary between total and partial reflection passed down beneath the point of contact, and the central dark spot was left isolated in a bright field. Now, when the rings were formed between a prism with a slightly convex base and a plate of silver, and the angle of incidence was increased so as to pass the critical angle, if common light be used in lieu of a simple spot, we had a ring which became more conspicuous at a certain angle of incidence well beyond the critical angle, after which it rapidly contracted and passed into a spot. Prof. Stokes explained that

to study the phenomenon in its purity, we must employ polarised light, or, what was more convenient, analyse the reflected light by means of a prism.

Sir Wm. Thomson explained that the very important discovery now given to the world had been made by the Professor a good many years since.—Prof. Stokes said that, while he had discovered the great truth many years ago, he had not completed the necessary investigations till now.

Mechanical Action of Light.—Mr. William Crookes, F.R.S., gave a lecture early in the year, at the Royal Institution, on his more recent researches on the effect produced by radiation upon very delicate balances suspended in the most perfect vacuum he can procure by means of Sprengel's excellent air-pump, amply supplied with gauges and other means for obtaining accurate measurements of results. His investigations began through his observing movements in substances which he was weighing by a chemical balance about three years ago, and for which he could not then account. Among other results, he found that the radiation of a warm body, such as the hand, a lighted candle, or hot metal, attracted the arm of a delicate balance when air was present in the glass vessel, but repelled it when a good vacuum was obtained; and he also ascertained that there is a decided difference between the action of light and radiant heat. The balance obeyed the force of the light of a candle more than that of heated copper. He could give no answer to the question whether the effect is due to light or heat, since, as he said, there is really no evidence of their separate identities, physically speaking. There are energetic calorific and chemical rays beyond the limits of the spectrum visible to us. Eventually, Mr. Crookes was led to the construction of his radiometer, or light-mill, which consists of four crossed arms of very fine glass, supported in the centre by a needle-point, having at the extreme end thin discs of pith.

After duly explaining this apparatus, and the means adopted to remove all interference to continuous action, he exhibited it in action, and then proceeded to show how it may be applied to the measurement of light; since, when the heat-rays are entirely cut off by means of an alum screen, or otherwise, the instrument becomes an accurate photometer. He ascertained that the arms move with more or less velocity under the influence of radiation, the rapidity of revolution being directly proportional to the intensity of the incident rays. With one candle he found that the mechanical action of the light is inversely proportional to the square of the distance. Two candles at the same distance give double the velocity of one, and so on. The time required for one revolution produced by a candle five inches off behind green glass was forty seconds; through light red glass, twenty seconds.

Proceeding to practical applications, Mr. Crookes explained how his radiometer may be employed as a test for the illuminating power of coal-gas and other sources of light, and how it may also become of great value in photography; and he also showed how the principle may be utilised by means of small magnets connected with the rotatory apparatus and a Morse's electric apparatus. A graphic record can thus be obtained of the amount of light falling upon an elevated position, such as the summit of a mountain, which would contribute an additional item to meteorological observations. Finally, he referred to experiments relative to the measurement of this force; and in the lec-

ture theatre, by his excessively delicate apparatus, he ascertained the weight of a ray of candle-light, six inches off, to be 0·00162 of a grain. He estimated the force of the light of the sun to be at the rate of 32 grains per square foot, or 57 tons per square mile: about 3,000,000,000 tons on the whole earth—a force which would drive the globe into space if it were not counteracted by gravitation.

Crookes's Radiometer.—At a recent meeting of the New York Academy of Sciences, held at the Stevens' Institute, Professor Mayer read a paper on Mr. Crookes's radiometer in connection with certain results obtained by the action of sound-pulses on an apparatus constructed in a similar manner. Describing how Mr. Crookes was led to the construction of the radiometer, Prof. Mayer said that a torsion balance, consisting of a bar of pith, was suspended by a fine filament. One half the length of this bar was blackened. On exposing this apparatus to rays from different parts of the prismatic spectrum, it was found that the torsion balance moved through spaces proportional to the thermometric effect produced by the same area of rays falling on a thermopile. Representing the motion produced by the ultra-red rays by 100, those of the other rays were as follows:—

Extreme red	85
Red	73
Orange	66
Yellow	57
Green	41
Blue	22
Indigo	$8\frac{1}{2}$
Violet	6
Ultra violet	5

The difficulty of ascertaining facts in nature, even by the most careful observers, is well illustrated here by the fact that Mr. Crookes overlooked the circumstance that he was here operating with a purely accidental spectrum, the proportion of whose parts depended entirely on the nature of his prism. Had he employed the normal or diffraction spectrum produced by the passage of light through finely-ruled "gitter" plates, his results would have been the same as those obtained many years ago by Dr. Draper.

Mr. Crookes found that the bar of the torsion balance was attracted when the apparatus contained air, and repelled when it was placed in a vacuum; also that the radiation from a candle on blackened pith was $5\frac{1}{4}$ times what it was on plain pith. From these observations to the construction of the radiometer was but a short step. Two fine wires, at right angles to each other, were provided with little vanes of mica blackened on one side, and the whole suspended on a pivot and inclosed in a glass vessel, from which the air was exhausted by means of a Sprengel pump. When rays of light fall on this apparatus, the differential action of the blackened and natural surfaces of the vanes gives rise to a continuous rotation. The rate of this rotation, and hence the intensity of the exciting cause, was obtained by means of a small electro-magnet placed in the apparatus in such a manner as to register the number of revolutions by making a series of dots on a slip of paper.

In order to measure the repulsion of a blackened surface in a vacuum, Mr. Crookes employed W. Ritchie's torsion balance, described in the "Transactions of the Royal Society" of 1830. This is so arranged that the repulsion of the blackened surface twists a fine glass thread, to which is attached a mirror projecting a beam of light on a screen. By means of a screw, the circumference of which is divided into 360°, the glass thread is turned

back again until the beam occupies its original position. The amount of torsion is then read off on the screw. The extreme delicacy of this instrument may be appreciated from the fact that the 1-100th of a grain produces a torsion through 10,000 degrees, or about 28 rotations of the thread. As it is sensitive to 1° of rotation, it is evident that we can thus weigh 1-10,000th of 1-100th = 1-1,000,000th of a grain. A candle at a distance of 6 in. repels 2 square inches of surface of blackened pith with a force of 0·001772 gr., at 12 in. distance with a force of 0·000444 gr. Starting out with the latter figure, and remembering that the effects are as the reciprocals of the squares of the distances, we should obtain at 6 in. a force of 0·001776, which differs from the result actually obtained by experiment by only the 4-1,000,000th of a grain.

After succeeding in constructing so perfect an instrument, it is not surprising that Mr. Crookes should be elated; but it is to be regretted that he should express himself as he did in the following extract from his paper: "A candle 12 in. off, acting on two square inches of surface, was found equal to 0·000444 gr.; the sun, equalling 1000 candles at 12 in., gives a pressure of 0·44000 gr.; that is equal to about 32 grs. per square foot, to 2 cwt. per acre, to 57 tons per square mile, or nearly 3,000,000,000 tons on the exposed surface of the globe—sufficient to knock the earth out of its orbit if it came upon it suddenly." It is true he immediately modifies this statement, but it is liable to be quoted without the following disclaimer: "It must be remembered that our earth is not a lamp-blackened body inclosed in a glass case, nor is its shape such as to give the maximum surface with the minimum of weight."

Still more mischievous, however, is the pretension to "weigh a beam of light." That it is not light which causes the rotation in Mr. Crookes's radiometer, has been conclusively proved by Schuster ("Proceedings of the Royal Society," April, 1876). He made a radiometer having one arm and a magnet. When a strong light fell on this apparatus, it overcame the directive force of the magnet, and caused it to rotate in the usual way. Now, on floating the instrument in water, and holding a magnet outside to keep it stationary in spite of the strong light falling upon it, the bulb began to rotate in a direction opposite to that which the light would have imparted to the vanes.

The only plausible explanation hitherto offered of the instrument is the following: The vacuum of the Sprengel pump is not a perfect one; but in the highly rarified air contained in the bulb, the molecules have a much greater amplitude of swing than in their ordinary condition, there being vastly fewer in the same space. Hence the currents set up by the very feeble heat of the rays of light, are sufficient to produce a much more intense action than could take place in dense air. The blackened surfaces become heated more than the natural ones, and consequently repel more particles, the reaction of which causes motion; and the apparatus being free to turn, the motion becomes one of rotation, which continues until the effect on the two surfaces become equalised. To show that the effect was due to heat, Prof. Mayer interposed a glass plate between the apparatus and the diffused light from a window. The effect was to stop the rotation by cutting off the heat rays, while the light rays passed through freely. Rotation was also produced by placing the hand near the radiometer.

What Sets the Radiometer in Motion?—M. Ledieu has presented a paper to the French Academy on some "Experimental Considerations on the Radiometer." These experiments are not favourable to the theory of the apparatus based upon the movements of gases and vapours remaining within the glass case after the vacuum has been made. This theory is subdivided into various doctrines, of which a very complete and lucid exposition has been given by M. Bertin in the June number of the *Ann. de Chim. et de Physique.* The capital objection which mechanicians oppose to these different explanations is, that the radiometer is an instrument of reaction. But in such apparatus, having regard to the impossibility of the motive power being rapidly produced with a sufficiently constant intensity, there ensue merely rotations accompanied by retardations and bounds far from being reconcilable with the perfect regularity of the radiometer. Moreover, the theory in question expressly requires that there shall never be an equilibrium of temperature between the gas in the case and the discs of the radiometer. But how are we to admit that in every experiment this equilibrium is not ultimately established? Moreover, the rotation ought to stop at last, instead of maintaining itself indefinitely at the same speed. The author then cites certain experiments difficult to explain by the supposed movement of gases in the interior of the apparatus. Thus the instrument was heated nearly to redness, when it commenced turning, but the rotation was sensibly accelerated by the momentary presence of a single flame, which joined its action to that of the radiant heat. An apparatus was constructed with discs exclusively polished. On throwing a pencil of solar rays upon one of the two hemispheres of the glass case, a perfect rotation was obtained, without interruption, and as free and rapid as with an ordinary radiometer fully exposed to the light. The author bases his explanation of the phenomena upon a mechanical action of the "ether" perpendicular to the direction of its rays of propagation, and not in the same direction as these rays. This interpretation is calculated to calm the legitimate disquiet of the partisans of undulation. In Germany there is a leaning to an explanation based upon electricity. They rely upon the experiment that when a radiometer with discs exclusively polished, and where one of the hemispheres of the case is traversed by a continuous electric spark, the instrument takes a rapid rotation always opposite to the direction of the spark, this direction being understood according to the common convention. "In any case the radiometer of Mr. Crookes seems to us a serious instrument, and not a paradoxical apparatus destined to enjoy an ephemeral scientific repute, and then to rank as a mere physical amusement. Its experimental study, pursued under all modifications, and with an indefatigable perseverance, will certainly lead to important results as to the mechanical properties of the ether."

Life without Light.—An interesting discussion has recently taken place in the French Academy of Sciences, on the question of the influence of solar radiation, and of the green matter in the formation of the immediate principles of plant organisms.

M. Boussingault considers this influence to be indispensable, and that, if the solar radiation should disappear, life would be impossible. M. Pasteur, on the other hand, thinks that life might still continue in certain inferior plants, and occasion the most complete organic

growths. He cites as an example the life of the *mycoderma aceti*, which may take place in darkness on a liquid composed of alcohol, acetic acid, and mineral phosphates, the latter including phosphate of ammonia.

The *mycoderma aceti*, to which M. Pasteur alludes, is a remarkably curious organism, which serves as a medium between the oxygen of the air and a combustible body or fermentable matter, to produce combustion or oxidation. Fermentation of this kind has thus a special character, and differs from that set up by yeast or in other ways. The *mycoderma aceti* appears as continuous membrane, either wrinkled or smooth, upon the surface of liquids, while the same are undergoing acetic fermentation, and is generally formed of very minute elongated cells, whose diameter varies from 0·000059 to 0·000118 inch. These cells are united in chains or in the form of curved rods. Multiplication seems to be effected by the transverse division of the fully developed cells, which division is preceded by a median constriction. If we allow this cryptogram to develop itself on the surface of any organic liquid containing phosphates and nitrogenous organic matter, until the whole surface of the liquid is covered: then, if we remove the liquid without disturbing the membrane, and substitute an equal volume of water containing 10 per cent. alcohol, the plant immediately sets up a reaction between the alcohol and the oxygen of the air. After a certain time the action, impeded by the great acidity of the liquid, becomes slower; but we can restore it to activity by substituting alcoholised water again. So that, as long as the *mycoderma* is supplied with suitable nutrition, it will go on and burn the alcohol; but if, on the contrary, we deprive it of nourishment, or in any wise diminish its vital activity, then its oxidising action will not go so far, and the alcohol may change into acetic acid. This is the substance of one of M. Pasteur's most brilliant investigations, among the practical results of which is a new commercial method for the acetification of fermented liquids. The process consists in sowing the *mycoderma aceti* on the surface of liquor containing 2 per cent. of alcohol, 1 per cent. of vinegar, and traces of alkaline and earthy phosphates. When the surface is covered with membrane, the alcohol begins to acidify. This action being fully set up, some alcohol, wine, or beer mixed with alcohol is added every day to the liquid in small quantities; the acetification is then allowed to terminate, and the vinegar is drawn off. The membrane is collected, washed, and employed for a new operation.

M. Boussingault's reply to the suggestion of the *mycoderma* by M. Pasteur is, that it is true that some parasites attain a complete development in an artificial medium containing nothing but definite and crystallised chemical compounds. Still there is a great difference between this development and that of chlorophyll in plants. The latter take all their elements from the exterior world, carbon from the atmosphere, hydrogen and oxygen from water. The parasites, even those mentioned by M. Pasteur, take carbon in substances which, although of definite chemical construction, are derived from vegetable organisms. Alcohol and acetic acid have their origin in sugar, which cannot be formed save under the influence of solar radiation. The existence, therefore, of parasites in an obscure place, where their cellules form immediate principles, similar to those produced in bright daylight by plants of green protoplasm, is far from being an

exception, as has been affirmed, but is rather a confirmation of the necessary relation of light and vegetation. Hence M. Boussingault adheres to his opinion that, if the sun's light were quenched, not only chlorophyll plants, but also those deprived of chlorophyll, would disappear from the earth.

M. Pasteur's position appears, however, to be unassailable, as might well be expected from his immense experience and wide investigations touching the subject under discussion. He simply points to the fact that, by known methods of synthesis, chemists starting with carbon and watery vapour can produce alcohol, acetic acid, and many other substances capable of serving as carbonated aliment of inferior plants deprived of light. Moreover, it may be conceived that, under the influence of the same, all the carbon existing at the surface of the earth, or in the interior, might pass into complex organic matters, and that ulteriorly it would return to the atmosphere in the form of carbonic acid through the actions of oxidation and fermentation. It would be only when this termination was reached, that all manifestation of life would be impossible without the aid of solar light.

M. Pasteur's experimental determination that oxygen and light are not essentials of life, and his having caused organisms to exist in an atmosphere of carbonic acid, and in absolute darkness, are among the greatest triumphs of modern chemistry.—*Scientific American.*

Sight, and what it tells us.—An interesting lecture on this subject was delivered in February, 1876, at the London Institution, by Professor W. K. Clifford, M.A. The lecturer began by speaking of the growing interest with which the theory of vision was now studied, and of its importance in the intellectual development of mankind. It was felt that by this gateway, if by any, we must pass from the world of mere phenomena to something greater behind. Indeed, it might be said with truth, that by means of this theory the chasm between the objective and subjective spheres had at last been bridged.

It was from this point of view that Professor Clifford proposed to treat the topic he had chosen. The sensation of sight was made up of impressions of colour and feelings of muscular movement, and so does not ultimately differ from a feeling of pain or pleasure. The notion of a house or of a theatre, as brought before the mind by the mechanism of sight, might be analysed into feelings of solidity, colour, and resistance. These feelings or impressions were a language telling us about the objects beheld—viz., every group of sight impressions suggested other possible sight impressions, muscular actions, and consequent sensations of all kinds. The immediate feelings and the suggested feelings are all in the beholder's mind. But the perceived object itself means something more. It implies the possibility of a like series of feelings in other people's minds. This something, said the professor, is external to me, this social object, as it may be called. It is the same thing as your perceptions, as distinguished from my perceptions. But the question arises, is there not something else behind the perceived object different from our perceptions? Most certainly there is, but sight does not tell us anything whatever about that something.

To return from the metaphysical to the physical side of the problem, what we perceive is represented by movements in the brain, which is made up of certain lumps of grey matter, and that perception is a totally different thing from the external fact which it symbolises. In short, we see with the eyes just as

we see with a telescope. Each eye was a box with a hole in it. It was filled with a transparent fluid, and behind was a network or retina, on which the picture was thrown, just as in Sir Charles Wheatstone's stereoscope. From the two flat or slightly curved pictures, taken from different points of view, the mind built up solid forms, just as from the three fundamental rays, red, blue, or green, and violet, it clothed the pictures with all the various colours. The nerves conveyed the news of these patches of colour to the brain, and produced a flutter among the points of grey matter of which it was composed. But the agitation of this grey matter must not be confounded with the simultaneous mental consciousness. The mind made as much out of the news of these dots of colour as the frightened boy passing through the churchyard did out of the broomstick he mistook for a bogey. The perception of, the object was quite different from the object itself.

Bishop Berkeley's doctrine of idealism was then stated in the great metaphysician's own words:—"Some truths there are so new and obvious to the mind that a man need only open his eyes to see them. Such I take this important one to be—viz., that all the choir of heaven and furniture of the earth—in a word, all those bodies which compose the mighty frame of the world have not any subsistence without a mind; that their being is to be perceived or known; that consequently so long as they are not actually perceived by me, or do not exist in my mind or that of any other created spirit, they must either have no existence at all, or else subsist in the mind of some Eternal Spirit—it being perfectly unintelligible to attribute to any single part of them an existence independent of a spirit. To be convinced of which the reader need only reflect and try to separate in his own thoughts the being of a sensible thing from its being perceived."

Professor Clifford said it was remarkable to what an extent the progress of science had tended to confirm Berkeley's conclusion. The visible world exists only in our minds, so far as could be scientifically demonstrated, although there may be something invisible which it represents.

To sum up, sight is an aggregate of colour-feelings and muscle-feelings. The objects of sight ... groups of such feelings, suggesting, added the professor, other feelings both in me and in other people. But, having thus pulled that world to pieces, let us put it together again. The words you hear me speak are groups of tones variously stopped and variously gliding into one another, but that does not make a lecture. So the sight of a mountain does not make a mountain, nor the sight of a lump of iron ore, that lump of iron ore. All the suggestions which go along with the sensation interpret it, just as a language is interpreted. A sensation calls up a conception, which is made up of an aggregate of beliefs, and is a link between sensation and action; it groups about the object all the rules of action for man which are important from his point of view; it expresses the practical relation of man to the object. We live in a world of conceptions. The things we see and think about are things we must talk about, and language relates to conceptions. What diverse conceptions of the sky, for instance, were formed by the peasant, the meteorologist, the painter, the astronomer, and the philosopher, and how differently they talked about it? Yet they all saw the same sky. Ours was a world of beauty and order, but this beauty and order are not in the eye-message, but in the correct interpretation of it, and this lays

hold of a selection out of infinite possible groupings of the phenomena for the purposes of man.

The History of the Radiometer.—Dr. G. Berthold makes an interesting contribution to the history of the radiometer. It appears that in a paper "Eclaircissement sur le traité physique et historique de l'aurore boréale," published in the *Memoirs* of the Paris Academy for 1747, M. Mairan gives a description of a light mill. This was a horizontal wheel of iron about three inches in diameter, having six radii; at the end of each radius was a small oblique vane. The axis of the wheel was held by its upper point to the end of a magnetic bar. The weight was only thirty grains. Light was concentrated on it with a lens. "Nothing could be more mobile," says M. Mairan, "than this wheel; but at the same time nothing is less certain than the induction one might wish to draw from it in favour of an impulsion by the rays. The machine turns now in one direction, now in the other, according as you bring one of its vanes more or less near to the bars, within or beyond the latter. It is necessary to conclude that the luminous rays attract and repel at different points of the cone which is formed by the lens, but the explosion of a mass of air suddenly and unequally heated round the vane where the focus is applied, appears to me to give a sufficient reason for these effects. The perpetual obstacle of the air naturally suggested to me to make one of these experiments *in vacuo*, but I avow that after having reflected a little on what might be the result, I have not thought it worth while taking the trouble." The reasons which thus unfortunately prevented M. Mairan from repeating his experiments *in vacuo* were, (1) the difficulty of producing a sufficient vacuum; (2) the idea, that beside the atmospheric air, there was another fluid, which would penetrate the glass and make the experiment doubtful; (3) through action of the burning-glass, vapours would rise from the body *in vacuo*, which would, by their impulsion, set it in motion. Dr. Berthold further notices an observation by Michell in Priestley's "History of Optics;" a piece of piano string, ten inches long, having a square copper plate at one end, and a grain of shot at the other, was pivoted in a case having its cover and one side of glass. Solar rays directed from a concave mirror on the copper plate produced repulsion. Priestley considered that this motion must not be attributed to impact of the light rays.—*Nature.*

IX.—SOUND.

Sounds Extinguishing Sounds.—Professor Mayer, of the Stevens' Institute of Technology, has shown that certain sounds extinguish the sensation of other sounds. The rule appears to be, that while low sounds cannot extinguish high ones, the high sounds may obliterate low ones. He demonstrated this by an apparatus producing a certain low note from a wind instrument simultaneously with the same note several octaves higher, and of greater intensity. The high note killed, so to speak, the low one. But, on the other hand, a low note of great intensity was powerless to extinguish a faint high note; the high note utterly refused to be drowned by any volume of the lower sound. The discovery is of great value to the grouping of an orchestra. Perhaps to provide the best music for the audience, the conductor should be in the middle of the room.

Music from Gas Burners.—A rather numerous company met recently at the house of M. Frederic Kastner, in the Rue de Clichy (says the Paris correspondent of the *Times* in the beginning of the year) to witness his experiments with a strange invention of his, which he calls the "Pyrophone." The pyrophone, as its name indicates, is an instrument which produces sounds by means of gas jets. It had long been known that flames emitted sounds, and M. Kastner himself had tried experiments in London. The special public at M. Kastner's house found themselves in the presence of an almost complete instrument composed of a series of glass tubes similar to organ-pipes, of different lengths and dimensions, in which gas jets were burning, and which played some very powerful and very moving *morceaux.* The difficulty of the invention consisted, of course, in regularising the jets. The theory is this :—When an isolated gas jet produces a sound, you have only to bring another similar jet near it to make the sound cease. M. Kastner, then, has invented a contrivance which opens and shuts like the fingers of a hand of which each one should allow a jet to escape. When the fingers are extended the sound is produced ; when they are closed or approached to each other the sound ceases. He next regulated the force of the sound by the dimensions of the tubes, and by the height at which the jets were placed in the tubes. The contrivance corresponds to the keyboard of a piano, and you are deeply moved at hearing those jets sing with extraordinary power, purity, and correctness. The audience was still more astounded at suddenly hearing the gaseliers placed in the centre of the room, and set in motion by invisible electric wires, execute "God save the Queen" in sonorous and penetrating tones. The invention is still in a rudimentary state.

The Elliptical Violin.—A violin on a new model, invented by Prince George Stourdza, has been tried at Vienna with not altogether favourable results. Setting forth on the principle that the ellipse is the most favourable geometrical figure for acoustical effect, Prince Stourdza made his fiddle of elliptical form. He endeavoured thus to augment the volume of the sound, which would be a desirable attainment,

and also to bring the tone as near as possible to the timbre of the human voice, which would be as certainly undesirable. Neither of these results did the inventor attain. Herren Helmsberger, father and son, Karl and Popper, did their utmost with the instrument, but could not evoke the absent power, nor bring out but a nasal and troubled tone. So ends the elliptical violin.

Sounding Powers of Various Metals.—M. Decharme has been studying the comparative sound-power of various metals. His experiments were made on cylindrical rods, 2 decimetres in length, and 1 centimetre in diameter, suspended by thread, or supported on the edges of cork prisms. The rod was struck at its centre with a wooden hammer covered with indiarubber. The minimum number of vibrations (690) was given by lead, the maximum (2762) by aluminium; the intermediate numbers, neglecting fractions, were:—Gold, 976; silver, 1034; tin, 1161; brass, 1303; bronze, 1381; zinc, 1422; copper, 1642; cast iron, 1843; wrought iron, 2192; steel, 2322. The duration of the sounds was in the following proportions (in seconds):—Lead, 0·3; tin, a little less than 1·0; zinc, 1; cast iron, 2·0; copper, 5; wrought iron, 12; brass, 14; bronze, 24; steel, 45. The sound produced by steel placed on the cork prisms lasted only 25 seconds, not more than half the time of its duration when suspended by a thread, and struck in the same way in each case. Bronze, on the contrary, gives a sound lasting 25 seconds on the cork, against 24 when suspended.

New Tuning Forks.—A tuning-fork, with variable tone, is described by Dr. König in *Poggendorff's Annalen*. The arms are perforated in the direction of their length, and the two canals are connected by a cross canal at the bottom. With the system thus formed communicates a little reservoir of mercury with attached screw. By varying the pressure on the mercury with the screw, the liquid can be raised up to the top of the arms, or allowed to entirely flow back out of them, and thus the sound of the fork can be varied. As the forks filled with mercury would, after excitation with a bow, give but a short sound, they are kept in continuous vibration by electrical means.

What Sounds we can Hear.—Professor Preyer has endeavoured to fix the lowest and highest limits of pitch within which musical tones can be perceived, by means of experimental methods of greater precision than any that have been hitherto employed for the purpose. The minimum limit for the normal ear was found to lie between sixteen and twenty-four single vibrations per second; the maximum limit reached 41,000; but many persons with average powers of hearing were found to be absolutely deaf to tones of 16,000, 12,000, and even fewer vibrations. Professor Preyer then proceeds to inquire into the power of discriminating relative pitch and of appreciating musical intervals. He also treats of silence, defining it as a state of uniform minimum excitation of the auditory nerve-fibres, and joining issue with Fechner and others, who deny its claim to be regarded as a positive form of sensation at all. Fechner distinguishes between the effect of absence of light upon the eye, and that of absence of sound upon the ear; black he regards as a sensation, silence as an absence of all sensation. Preyer points out, on the contrary, that the two cases are in every way analogous, and that the auditory organ never sinks, any more than the retina, below the zero of sensation. The pressure of the fluid contents of the labyrinth, and the flow of blood through the vessels, must give rise to sensations of which

we are unconscious only because of their uniformity, their constancy, and their low degree of intensity. Silence, when the attention is concentrated on the sense of hearing, is found to vary in degree, just as the blackness of the visual field, when light is excluded from the eye, has been observed to vary. But the complete absence of sensation is obviously incapable of varying. Lastly, the parallel between the auditory sense and that of vision is borne out by a study of the entotic sensations which may be produced artificially, and which are closely analogous to well-known entoptical phenomena.

Machine for Writing Spoken Words.—A machine for writing spoken words has been invented by M. H. Huppinger. The *Revue Industrielle* describes the machine as being about the size of the hand. It is put in connection with the vocal organs,—the instrument recording their movements upon a moving band of paper in dots and dashes. The person to whom the instrument is attached simply repeats the words of the speaker after him inaudibly. This lip language is then faithfully written out.

Sounding Powers of Various Woods.—M. Decharme, whose experiments as to the sounding powers of various metals we have just mentioned (*see* p. 105), has made similar experiments (we learn from *L'Institut*) on different kinds of wood. Notwithstanding the diversity of the kinds of wood examined (38 species and 14 varieties), they were all found to give sounds comprised in the interval of an octave. The most grave sound is mi_4 given by box; the highest mi^5 given by Northern fir. M. Decharme gives a list of the sounds emitted by different woods between the two extremes. The range of sounds from the metals extended from 690 vibrations—for lead—to 2762 vibrations for aluminium. Sounds from wood are comprised between those for brass—1303·62—and aluminium—2762. This is no doubt partly accounted for by the much less range of densities in woods than in metals. Still there are anomalies. Thus, the willow, which, after the poplar and certain firs, was the lightest of the woods experimented on, gives the same note—sol_4—as ebony, which is the heaviest after the palm and the palisander. It was difficult to appreciate the intensity and the duration of the sounds, but palisander, logwood, walnut, and acacia, were in the front rank in this respect. (The duration of the sounds did not exceed the fraction of a second, 0·5 to 0·7 for the most sonorous palisander.) Northern fir and poplar had the clearest timbre.—*English Mechanic.*

Photographing Sound.—Dr. König has succeeded in photographing sound, or rather the vibrations causing sound. In the supply-pipe of a burning gas-flame he has an opening closed by an elastic membrane, and if any one speaks or sings, or a tuning-fork is held against the membrane, its motion is transmitted to the gas-flame. A mirror, drawn along by clockwork, reflects the image of the flame, which is seen as a curve whose form varies with the pitch of the sound. This curve of light is then photographed. Dr. Vogel suggests cyanogen as a gas giving a powerfully actinic light.

A Sound Writer.—A sound writer, called an opeidoscope, is a new invention. On the end of a 2-in. tube is pasted a piece of thin rubber or tissue paper. In the centre of this is fastened a piece of looking-glass, ⅛ in. square. Hold this end in the sun and the other end in the mouth, and sing or speak in it. The ray of light reflected from the mirror falling on a white surface describes curves and patterns differing for every pitch and intensity, while the conditions give uniform results.

The Radiometer and Sound.

—It has been observed by M. Jeannel that certain sonorous vibrations cause rotatory movement in the radiometer. In half obscurity, three radiometers were placed on the interior tablet of a chamber organ. The bass notes, those of the three first octaves, produced rotation, the most bass acting most, but *fa* and *fa* sharp of the lower octave (especially with the bourdon stop) produced more rapid rotation than *ut*, *re*, and *mi*, though these are more grave. Radiometers do not all act in the same manner, as to rapidity and direction of their rotation. Thus, to the low *fa* or *fa* sharp radiometer A, the less sensitive to light, made about one turn per second, the black faces first (*i.e.* a direction opposite to that produced by light), whilst radiometers B and C, which were more sensitive to light, turned more slowly and in the direction of the movement produced by light. M. Jeannel explains these effects by circular or angular vibrations of the supporting needle transmitted from the tablet of the organ. By applying the finger to the top of the radiometer, one may prevent the vibration and also the rotation. The board of a piano produces similar effects, but in a less degree. If the experiments indicated be made where the diffuse light is nearly sufficient to drive the radiometer, grave sounds, even the weakest, cause rotation in the ordinary direction (bright surfaces first); the rumble of a vehicle will suffice. Here the light is at first insufficient to overcome the friction, but when the vibrations intervene, friction is lessened during certain intervals, and the apparatus is thus rendered more sensitive to light.—*Nature.*

Musical Sand. — Mr. Frink states, in the "Proceedings of the California Academy of Sciences," that in order to ascertain, if possible, "the cause of the sound that is produced by the sand from Kauai presented to the Academy at a former meeting, I investigated its structure under the microscope, and I think the facts I have ascertained fully explain the manner in which the sound is produced. As the grains of sand, although small, are quite opaque, it was necessary to prepare them so that they should be sufficiently transparent to render their structure visible. This was effected by fastening them to a glass slide, and grinding them down until one flat surface was obtained. This surface was then attached to another slide; and the original slide being removed, the sand was again ground down until sufficiently transparent. The grains were found to be chiefly composed of small portions of coral and apparently calcareous sponges, and presented under the microscope a most interesting object. They were all more or less perforated with small holes, in some instances forming tubes, but mostly terminating in blind cavities, which were frequently enlarged in the interior of the grains, communicating with the surface by a small opening. A few *foraminiferæ* were also met with, and two or three specimens of what appeared to be a minute bivalve shell. Besides these elements, evidently derived from living beings, the sand contained small black particles, which the microscope showed to be formed principally of crystals of augite, nepheline, and magnetic oxide of iron, imbedded in a glassy matrix. These were undoubtedly volcanic sands. The structure of these grains, I think, explains the reason why sound is emitted when they are set in motion. The friction against each other causes vibrations in their substance, and consequently in the sides of the cavities they contain; and these vibrations being communicated to the air in the cavities, under the most favourable conditions for producing sound, the result is the loud noise which is caused when any large

mass of sand is set in motion. We have, in fact, millions upon millions of resonant cavities, each giving out sound which may well swell up to resemble a peal of thunder, with which it has been compared; and the comparison—I know from others who have heard it—has not exaggerated. The effect of rain in preventing the sound is owing to the cavities in the sand becoming filled with water, and thus rendered it incapable of originating vibrations" as in dry weather.

X.—ELECTRICITY AND MAGNETISM.

The Velocity of Magnetism.—In order to remove all doubt as to the accuracy of the results of preceding investigators, Dr. Herwig has sought to determine the velocity of transmission of magnetic influences by separating the various portions of his apparatus to very considerable distances; and he concludes that if the action of the terrestrial magnetism really possesses a definite velocity, it must amount to at least a half million miles per second; or, in other words, that the terrestrial magnetic influence makes itself felt at any point of the earth's surface in less than one three-hundredth of a second.

Lighting-up the Deep Sea.—To form an electric submerged lamp a balloon-shaped glass vessel, protected by a metal cage is, according to the invention of Messrs. Chauvin, Goizet, & Aubry, of Paris, hermetically closed, preferably by an indiarubber plug. The plug is traversed by two metal rods isolated electrically. At the ends of these rods two ends of a platinum thread rolled into a spiral are fixed, which when traversed by the electric current is heated to incandescence and emits light. The generating pile is contained in a separate box, and conductors communicate the established current to the platinum thread.

Electricity for Sewing Machines.—A new electric motor, the invention of Mr. C. A. Hussey, of New York, is at work driving a sewing-machine. The engine, which is quite small, is operated by five Bunsen cells, and its movements are controlled by a simple device by connecting or disconnecting a greater or less number of elements. The machine is driven at the rate of 560 stitches per minute. Mr. Hussey's engine combines several new and excellent improvements.

Something like a Spark.—It is said that Messrs. Warren de la Rue and Spottiswoode estimate, from experiments made on their chloride of silver battery, that 100,000 cells would give a spark in air nearly 9 ft. in length.

A Compass without a Magnetic Needle.—A novel idea has been started by an ingenious Dutchman, who declares that he has invented a non-magnetic mariner's compass—that is to say, an instrument which will direct a ship's course without a magnetic needle. The principle of this wonderful discovery is as yet a profound secret, but we are ambiguously informed it consists of the application of "notorious physical powers to an instrument used in practical navigation, the improvement of which was a desideratum since long"—a sentence which will reveal the fact that our clever friend might with advantage polish his English a little. His description of his invention is as follows:—"Whereas the actual compass is directed by magnetism, it is in this case a well-known physical power that puts in motion the whole of the wheelwork. The instrument, suspended in a Cardanus' apparatus, and protected as much as possible from heavy shocks by means of indiarubber, &c., as is the way with chronometers, consists, when seen on the top, of a ring, inside of which are found three circles. The ring, just like the card of a compass divided into points and degrees, is

fixed at the instrument, and turns round with the vessel. Over this card two hands move concentrically with equal swiftness and in opposite direction; consequently in each turning they will cross each other twice, and the junction of these points will denote a direction that on the card points out the true course of the vessel."

Electric Lights for Ships.—The Imperial Russian yacht *Livadia* has been illuminated by means of the electric light. Mr. Reed, writing from Nicolaieff, says the yacht, "like some other of the Emperor's vessels, is furnished with a powerful magnetico-electric light at the bow, which is said to be very effective in lighting the path of the ship a long way in advance of her."

A Trap for Burglars.—A very neat device for preventing burglary has just been brought out in the United States. All doors in a bank are so arranged that they can only be opened when two knobs or handles are turned simultaneously. Now, these knobs are placed in connection with powerful batteries. A thief seizes one knob, and no effect follows. He then uses both hands, taking a knob in each. Immediately his howls follow; he is unable to let the knobs go because of the violent muscular contractions set up. The torture is fearful, and the would-be robber constitutes, in consequence —if he be a man of strong lungs—a most admirable alarm.—*Engineer.*

Lightning Figures.—A young man named George Boner, while ploughing corn near Newark, Ohio, was struck by lightning and instantly killed. A bluish black discolouration of the body extended from the neck to the hips. On his breast was found engraven the likeness of a large tree which stood within a short distance, the branches of which projected naturally to each shoulder, forming a representation —at least so it was said—so perfect as to render the leaves plainly visible.

A New Form of Lightning.—In a paper addressed to the Academy of Sciences, M. G. Planté adverts to the memorable storm which broke over Paris on the 18th of August. On that occasion the flashes of lightning were remarkable in more than one respect. The immense cloud that darkened the heavens emitted a series of flashes of great length and a variety of shapes, some forked, others presenting curves with nodes, or with closed outlines. These flashes seemed in general to be composed of bright points, not unlike those of the furrows generated on a wet surface by an electric current of high tension. But the most remarkable of all was one that, issuing from the cloud, described a lengthened S on its way to the ground, remaining visible for a measurable time, forming a sort of string of brilliant beads disseminated along the whole length of a very narrow thread of light. This flash, observed by M. Planté from the heights of Meudon, seemed to strike Paris in the direction of Vaugirard; and we know that several strokes of lightning occurred in that quarter. It is highly probable that the points thus visited were so simultaneously, and that the flash in question split into various branches, as perhaps beads in the immediate vicinity of the soil, as M. Planté believes, he having only seen one place struck from where he was. This formation of luminous beads, alternating with fiery lines is, in his opinion, a consequence of the flow of electricity through a ponderable medium, with a complete resemblance, either to the string of red-hot globules, which a long wire melted by the voltaic current presents, and the extremities of which remain for an instant in the state attached to the poles of the pile, or else to the nodes resulting from the

outflow of any liquid from its reservoir. M. Planté considers this form of lightning to constitute a peculiar feature showing the transition of the ordinary continuous flash to the globular form. Thunderbolts in the shape of fiery balls may be considered as resulting from beads condensed; if this has not been observed on the spot where they fell, it is because the observer, placed too close to the phenomenon, can only see a part of it, while the one at a distance takes in the whole. M. Planté proposes the name of "beaded lightning" for this form.

On Thunder-Storms.—The fact has lately been ascertained by M. Berthelot, from various experiments, that free nitrogen is absorbed by organic matters at the ordinary temperature, under the influence of the effluve or silent electric discharge. He has observed it (among other substances) with benzine, essence of terebinthine, marsh gas, and acetyline. Thus one gramme of benzine will absorb in a few hours 4 to 5 cubic centimetres of nitrogen, the greater part remaining unaltered. In view of such facts it is hardly doubtful, M. Berthelot remarks, that similar phenomena, accompanied by an absorption of oxygen, may occur in thunder-storms whenever the air is electrified, which is after all its normal state. This absorption of nitrogen and oxygen, along with molecular condensations and other chemical changes in the tissues, under influence of the electric effluve, may cause corresponding physiological changes, which may play an important rôle in those curious maladies often manifested by the human organism during thunder-storms.—*English Mechanic.*

Gramme's Magneto-electric Machines.—M. Tresca has recently made some determinations of the force consumed by Gramme's magneto-electric machines when used for producing the electric light for illuminating purposes. Experiments were made with two machines, the illuminating powers of which were respectively equivalent to 1,850 and 300 Carcel burners. The force consumed by the first in terms of burner per second was 0·31 kilogrammetres, by the second 0·69 kilogrammetres; from which it appears that the expenditure of force is relatively much less for a large than for a small machine. The machines worked steadily for an interval sufficiently long for the absence of sensible heating to be relied on. Under the conditions of working of the larger machine, the author states that the consumption of fuel represented only the hundredth part of oil, and the fiftieth that of coal-gas, requisite to produce the same illumination. The paper is in the *Comptes Rendus*, LXXXII., p. 299.

Electric Illumination.—Experiments have lately been made in Paris on the lighting of the large halls of railway stations by means of Gramme's magneto-electric machines. From the numerical results tabulated (*Comptes Rendus*, 10th April), M. Tresca's observation, mentioned in the preceding paragraph, is confirmed, that the force necessary to produce a unit of electric light, or 100 Carcel burners, increases very quickly as the total quantity of light diminishes. The force necessary to cause the formation of the voltaic arc is about 10 per cent. greater than when the carbon points are in contact. A little more force was necessary with carbons of 0·009m. than with those of 0·007m. The force varies little with the types of 50, 100, or 150 burners. Comparing the expense of electric lighting with that of gas lighting, the former is shown to be only about a fifth or a seventh of the latter. In stations lighted by only one electric lamp, the shadows that were cast were observed to be troublesome, and it

is recommended that there should, in most cases, be two lamps which may lessen each other's shadows. To avoid the dazzling effect, the voltaic arc is inclosed in a globe of white ground glass. The rays passing upwards are returned by a reflector.—*English Mechanic.*

Electricity for Merchants and Manufacturers.—Professor Palmieri has discovered a new instrument which he calls a "diagometer," and which is constructed for the rapid examination of oils and textures by means of electricity. What the apparatus will do, Professor Palmieri details thus:—1. It will show the quality of olive oil. 2. It will distinguish olive oil from seed oil. 3. It will indicate whether olive oil, although of the best appearance, has been mixed with seed oil. 4. It will show the quality of seed oils. 5. Finally, it will indicate the presence of cotton in silken or woollen textures The professor has been complimented for his invention by the Chamber of Arts and Commerce at Naples, who have published a full description of the apparatus, with instructions for use.

Magnets and Magnetism.—MM. Treve and Durassier, in the course of some experiments on the action of acids on magnets, arrive at the conclusion that magnetism, far from being confined to the surface, penetrates to the very centre of the steel. They affirm the conclusion that the penetration of magnetism into the entire mass of a piece of homogeneous steel, magnetised to saturation, is a general fact; or that the magnetism, at first superficial, penetrates successively into the mass, in proportion as the outer layers are dissolved away by an acid.

Sawing by Electricity.—Mr, G. Robinson has patented a new process for sawing wood. The process consists in substituting a platinum wire for the saw. The wire is heated to a white heat by the passage of an electric current. The wire, to which a forward and backward movement is given, cuts across the hardest woods with inconceivable ease. Constantly maintained at a white heat by the electric current, it advances in the wood by carbonising the surface which it touches, but this carbonisation is entirely superficial, and has no bad effect.—*Telegraphic Journal.*

Silkworms hatched by Electricity.—Silkworms hatched by electricity, according to the *Live Stock Journal and Fanciers' Gazette,* are now being reared in Italy. The superintendent of the Italian Experimental Silkworm Farm at Padua has found that the hatching of silkworms may be accelerated by ten or twelve days, and a yield of 40 per cent. of caterpillars secured, by exposing the eggs to a current of negative electricity from a Holtz machine for eight or ten minutes. It is suggested to apply the method to hens' eggs, and to hasten the germination of seeds.

Writing by Electricity.—Our attention has recently been called to a remarkable invention—the electric pen, recently introduced from the United States. The patentee is Mr. T. A. Edison, who has a world-wide fame as an electrician, and is well known here as the inventor of the Stock Exchange Indicator. This startling improvement is, in fact, an instrument for the production of manifold copies either of writings or drawings. It consists of the pen proper, a small electric battery, and a duplicating press. The pen is a hollow tube, containing a fine needle, the tube is fitted with an electro magnet; when placed in connection with the battery the needle is projected from the tube with amazing rapidity, the number of strokes being at the rate of five or six thousand per minute. These strokes pierce the paper with

a series of fine holes, each of which is invisible, though to the naked eye the whole appears like a number of fine lines traced on the superfices. The paper, thus converted into a stencil, is afterwards placed in a press, and, by means of a roller and appliances similar to those required in stencilling, copies are produced at the rate of six or eight per minute. The impressions are exceedingly fine and wonderfully accurate. The electric pen, with all its appliances, is easily managed, and has the great advantage of being *clean*, and of printing in ink of *any* colour. It appears to have had unusual success in the United States, where, we are told, no less than eighteen hundred have been sold since its first introduction a few months ago. It is a form of invention in connection with electricity, which is, at least, interesting, and may create revolutions in the art of writing, and particularly in those sister arts which are charged with the production of many copies of an original. The pen has always been recognized in civilized communities as mightier than the sword; but if the restless inventiveness of man has brought us to the "electric pen," this formidable weapon must have acquired a new and tremendous power, and the pen of the ready writer will more than ever electrify the world. —*The Monetary Gazette.*

Church-bells in Thunder-storms.—A French clerical journal, quoted by the *Revue Scientifique*, maintains that the tolling of the church bell is of much greater efficacy than the use of lightning-rods in warding off the effects of a thunder-storm, and advises the faithful to resort to the former means in preference to the latter.—*Nature.*

A New Telegraph Apparatus.—A new apparatus for telegraphic signalling has lately been brought before the Society of Arts. It is the invention of a Spanish gentleman, and its object is to provide a simple and inexpensive system by which any number of stations—houses, fire-offices, police-stations, &c.—may be able to communicate with a central station by the same wire, yet without interfering with one another. It is obvious that with any system of telegraphy now in use this cannot be done. When, as is frequently the case, there are more than two stations on a line, only two stations can communicate at any one time, all the others being kept waiting till these have done. The operator at any station wishing to send a message has to wait till the line is clear, and he then telegraphs all along it, "calling" the station with which he requires to communicate. The signal is given all along the line, but it is attended to only by the station called. Should any second station attempt to break in before the first has finished, it simply causes confusion and consequent delay. According to the new system the message may be said to wait on the line till all is clear, and then take its turn to be recorded at the receiving station without any further action on the part of the operator. The apparatus also is intended for use by persons without any knowledge of telegraphy, and can be set in action as readily as an ordinary electric bell. The arrangements by which all this is effected are at once so novel and so ingenious as to deserve notice, though it is but fair to add that—at least in its present state of development—it is not easy to suggest any practical application for the invention. The proposal of the inventor is, that by his system all the houses in a town or any district of a town might be put into communication with a central office, so that on any sudden emergency a message might be dispatched giving the locality of the house requiring assistance, and in-

dicating the character of the assistance required. Now, however tempting such a proposal may appear, it is certainly too elaborate, and would require too extensive an organization, for it ever to be likely to come into practical use, while for any system of communication less extended than this it is a question whether the simpler appliances now in use do not answer almost equally well. For use in large offices, hotels, hospitals, and other places fitted with electrical communicating apparatus, it would offer some advantages, particularly the considerable one of being able to send a variety of signals instead of a single one, but beyond this the practical value of the new system is not at once apparent.

There are, however, many points about the invention which render it interesting to those who have any acquaintance with practical telegraphy, and it may be worth while to try and indicate them, so far as can be done without entering too deeply into technicalities.

The way in which an ordinary telegraph line is arranged is of course familiar to most people. The wire connecting the two stations, after passing through the instrument, is at one end connected to the earth, while at the other end it is joined to one pole of the battery, the other pole being connected to the earth, through which therefore the electric circuit is completed. In small apparatus, for communication within a building, two wires are used, so that the circuit is completed by the second wire instead of by the earth, as is usual in all cases where the distance is at all considerable. The essence of the system under discussion may be said to consist of the use of two independent wires, the earth being in each case used to complete the circuit. Of these one wire serves to carry the message, the other to set the instruments and connections in a condition to carry it. This last may be termed the "starting," the other the "sending" wire. Both wires are led along the street or other main line of communication, and short branch wires connected to them are carried into each house. The battery is placed at the central station, where also is, of course, the receiving instrument. This is a "Morse" instrument, which records on a slip of paper the messages sent through it. In the normal state of the line this instrument is connected with the starting wire, but not with the sending. On a signal being sent through the starting wire, the instrument, previously at rest, is set going, the connection with the starting wire is broken, connection with the sending wire is made, and the message is received and recorded. The clockwork of the instrument is set to run a sufficient time to receive the message, and it then changes the connection back to the starting wire and stops. We must now go back to the sending apparatus, from which practically two signals are sent, one along the starting wire and the other—the message itself—along the sending wire. The starting wire may be said to pass through all the instruments, arrangements being made in each instrument for severing the connection there and connecting to a short earth wire. As soon as this is done, all the line beyond is cut off from the central office, and, the electric circuit being now completed through the earth, a current passes along the starting wire, and the receiving instrument is set in action. This being simultaneously disconnected, as above stated, from the starting wire, it cannot be interfered with until the message has been received and the instrument placed in a condition to be started afresh. It now remains to show how the message itself is sent. This is effected as follows:—the

electric current, as it passes along the starting wire, is caused to act on a magnet, and thus set in motion a small apparatus on the sending wire. This, by an arrangement of considerable ingenuity, but involving details too technical for description, severs the communication with stations beyond, and completes the circuit on the sending wire by connection with the earth. The current thus being enabled to pass, a signal is given, after which the instrument returns to its normal state. Thus the operator by one and the same action sends a message along the starting wire, which cuts off all communication between the starting wire and the receiving instrument, throws the receiving instrument into connection with the sending wire, and transmits his message. Nobody can send a message along the sending wire till he has sent one along the starting wire, since it is by the current flowing along the starting wire that his sending instrument is put in action. Nobody can send the requisite starting message while any one else is telegraphing, for during the process the starting wire is disconnected from the receiving instrument. Not only this, but if, while one person is telegraphing, another attempts to do the same, this second person, though he does not actually send his message, yet puts his connections in such a position that, as soon as the instrument at the central station has received the previous message and regained its normal position, the circuit with his instrument will be completed, and his message sent. Thus any number of persons can telegraph simultaneously, and their messages are received at the central office in the order of their position, those nearest the office being taken first. The signals transmitted are capable of considerable variety, according to the complexity of the instrument. They are given by the movement of a pointer hand on a dial. The signals required are marked on the dial face; and on the hand being brought to any given signal, that signal, with the number indicating the house, is recorded at the central office. The receipt of the message is shown by the return of the hand to the zero point. The principal signals suggested are for giving an alarm of fire, summoning the police, or desiring the attendance of a doctor. Street stations might also be arranged, from which a fireman or a police-constable might communicate with the central office.—*Times*.

What is Phosphorescence?—The phenomenon of phosphorescence has often troubled the chemist and the photographer, and there are no doubt among our readers some who have, at one time or another, endeavoured to obtain reflections of phosphorescence upon the photographic film. We have never heard of the attempt proving successful, for the luminosity given off is, after all, so faint that such a result is hardly to be expected. We see that a German philosopher has recently been directing his attention to phosphorescence, not from a photographic point of view, however, but in order to discover, if possible, the true cause of the remarkable phenomenon. The result of his investigation is, that he is enabled to confirm the conclusions arrived at by others—such as Hulme, Placidus, Heinrich—who have worked in the same direction. The simplest mode, so it appears, of bringing about phosphorescence, is to place marine fish in a three per cent. solution of salt, and, according to M. Pflüger, the pheuomenon may be observed the second evening. The luminosity, M. Pflüger tells us, begins in the eyes, and thence spreads all over the fish, increasing in intensity from day to day, its duration depending upon the temperature. The luminosity is of such a nature that the fish ap-

pears, after a time, to be luminous all through; but this is not the case, for, on scraping off the surface, it is quite black underneath. The luminous matter is, indeed, a kind of slime, which is perfectly apparent in daylight, when it is of a dirty white colour; it is only in the dark that it shines with a phosphorescent lustre. It appears that pretty well any animal matter may be rendered phosphorescent by applying to the surface some of this slime, or, in other words, can be infected by the slime. M. Pflüger has examined the slime under a microscope, and it was found to contain a mass of schizomycetes, which, from the fact that they moved actively about, were doubtless alive. Hence he concludes that the small living cells of the schizomycetes are the luminous agents. The animalculæ, he points out, are not so small that they cannot be filtered from any water in which they may happen to be. M. Pflüger in his paper proceeds to give the results of investigation of other decaying matter in which phosphorescence is observed; but we need merely quote the summing-up of his conclusions in respect of this mysterious question—viz., "all phosphorescence of decaying organisms is the luminous respiration of living parasites."—*Photographic News.*

Speaking by Telegraph.—The discovery of the electric transmission of sounds—made simultaneously, it would seem, by Gray, of Chicago, and La Cour, of Copenhagen—promises to be of considerable advantage in practical telegraphy. Professor Graham Bell, who claims to have demonstrated the possibility of thus signalling sounds of different pitch in 1873, has recently, before the Massachusetts Institute of Technology, demonstrated the possibility of conveying vocal sounds by means of the ordinary telegraph wires and special appliances for transmitting and receiving the sounds.

The apparatus used by Professor Bell is thus described:—Two single-pole electro-magnets, each having a resistance of 10 ohms, were arranged in circuit with a battery of five carbon elements—the total resistance being about 25 ohms. A drum-head of goldbeater's skin, about 2¼ in. in diameter, was placed in front of each electro-magnet, and a circular piece of clock-spring was glued to the middle of the membrane of each drumhead. One of these telephones was placed in the experimental room, and the other in the basement of an adjoining house. Upon singing into the telephone the sounds of the voice were reproduced by the instrument in the distant room; and if two persons sang simultaneously, the two notes were audible at the other telephoner.

At the time of the lecture an experiment was made to show the transmission of articulate speech, an assistant going into the adjoining building where one of the telephones was placed. Professor Bell then placed his mouth near the other telephone, and said, "Do you understand what I say?" An answer was returned, and, according to the report before us, articulate sounds were heard proceeding from the piece of clock-spring attached to the membrane, which were alleged to be, "Yes, I understand you perfectly." The articulation was, it is stated, somewhat muffled and indistinct, but at all events in this case was intelligible.

Several familiar questions were, it is said, understood after a few repetitions; but a critical analysis of the effects produced leads to the conclusion that the vowel sounds alone are those faithfully reproduced: diphthongal sounds and rotund vowels are readily distinguished, but consonants are generally unrecognisable. Now and then, however, a sentence comes out with almost startling distinctness,

the consonants as well as the vowels being clearly audible.

Professor Bell stated that telephonic effects can be produced with three varieties of currents—the intermittent, the pulsatory, and the undulatory. The first are characterised by the alternate presence and absence of electricity in the circuit; the pulsatory current by sudden changes in intensity; while undulatory currents are obtained by gradual changes analogous to the changes of density of air produced by vibrations of a pendulum.

In 1837 Page discovered galvanic music, or the fact that an electro-magnet gives forth a sound when suddenly magnetised or demagnetised a sufficient number of times in a second; and in 1874 Professor Bell discovered that the sounds were due not entirely to the magnetic condition of the iron core, but that a portion of the effect is produced by vibrations in the insulated copper wire forming the coil.

One of Professor Bell's first experiments in connection with telephony was to render the sounds of a reed organ audible to persons at a distance. A tense membrane was placed between the electro-magnet and its armature; and the reeds of the organ were so arranged as to open and close the circuit as they vibrated. When the instrument was played the sounds were "loudly reproduced" by the telephonic receiver on the lecturer's table. When chords were played, their component tones were simultaneously emitted by the armature of the receiver.

Electricity as an Executioner.—The revolting scenes sometimes accompanying the execution of criminals are well calculated to bring to public notice the disadvantages of hanging as a mode of capital punishment.

The teachings of science are heeded and sought for in the building of prisons, in the management and care of convicts, and in every modern correctional system; and yet in so simple and easy a process as the extinguishing of human life, they are utterly ignored.

The most certain and painless death known to science is caused by the lightning stroke, or by, what amounts to the same thing, the electric shock. When a powerful discharge of electricity is received in the body, existence simply stops, and the reason is obvious. Helmholtz has proved that, for any vibration which results in sensation, to reach the brain through the nerves, one-tenth of a second of time is required. Furthermore, time is also needed for the molecules of the brain to arrange themselves through the effect of that vibration, through the motions and positions necessary to the completion of consciousness, and for this an additional period of one-tenth of a second is expended. Consequently, if, for example, we prick our finger with a pin, it takes two-tenths of a second for us to feel and recognise the hurt. It can easily be conceived, therefore, that if an injury is inflicted which instantly unfits the nerves to transmit the motion which results in sensation, or if the animating power is suddenly suspended by an injury to the brain before the latter completes consciousness, then death inevitably follows with no intervention of sensibility whatever.

Now a rifle bullet, which traverses the brain in the one-thousandth of a second, manifestly must cause this instant stoppage of existence, and proof of this is found in the placid faces of the dead, and in the fact that there is nothing more common than to find men lying dead on battle-fields, shot through the brain, but with every member stiffened in the exact position it was in when the bullet did its work. But a rifle ball is slow beside the electric shock. Persistence of vision impresses a

lightning flash on the retina for one-sixth of a second, but its actual duration is barely one one-hundred-thousandth of a second.

The effect of the shock on the system is excellently described by Professor Tyndall, who, while lecturing before a large audience, inadvertently touched the wire leading from fifteen charged Leyden jars, and received the whole discharge through his body. Luckily the shock was not powerful enough to be fatal; but as the lecturer regained his senses, he experienced the astonishing sensation of all his members being separate and gradually fastening themselves together. He says, however, that "life was blotted out for a sensible interval," and he dwells with much stress upon the opinion that "there cannot be a doubt that, to a person struck by lightning, the passage from life to death occurs without consciousness being in the least degree implicated. It is an abrupt stoppage of sensation, unaccompanied by a pang." So much for the death which, by suitable alteration of the law, we would have substituted for slow strangulation. The next point is its practical accomplishment.

Instead of building a gallows and providing rope, the sheriff, advised by a competent electrician, would procure a powerful Ruhmkorff coil and a heavy battery. These instruments would rarely need replacing, and would last indefinitely for other executions. The battery and coil should be of sufficient strength to deliver an 18-inch spark. In case of there being more than one person to be executed, all of the condemned would be conducted with all due ceremony to the place of execution, the left hand of one man handcuffed to the right hand of his neighbour, and the conducting wire fastened to bracelets on the disengaged wrists of both criminals, if only two are to be hanged, or to the wrists of the outer men, if more than that number are to suffer. The culprits being seated so as to be seen by the legal witnesses, the sheriff presses a button. The current is instantly established from the coil, passes through the bodies of the men, and all is over. With a competent electrician, who might be a member of the police force, and especially charged with the duty, there would be no possibility of mistakes. The same ignominy which attaches to the gallows would be transferred to this mode of destruction, while the peculiar death by lightning, which, among the ignorant of all nations and ages, has been the subject of profound superstition, would, without doubt, through its very incomprehensibility and mystery, imbue the uneducated masses with a deeper horror.—*Scientific American.*

Electricity at the National Assembly of France.—The National Assembly at Versailles is illuminated by 356 gas burners, and these are lighted by electricity. The apparatus was constructed by M. Gaiffe, who had to deal with a difficult problem, as the burners were too far removed to communicate the light to each other. The system, which is largely adopted in this and other countries, of heating a platinum wire to redness by means of electric piles, was rejected, as it would have required a number of batteries, yet the lighting would still have been slow, and the wires would have been in great danger of being broken when the chandeliers and lustres were cleaned. M. Gaiffe adopted the system of lighting by the spark.

The apparatus consists of—1, a battery, with hydro-chlorate of ammonia and peroxide of manganese; 2, an induction coil; 3, a series of conductors, with a total length of 1,400 metres, so well isolated as to lose none of the charge, although the tension is immense; 4, 356 in-

flamers, one to each burner; 5, a contact breaker between the battery and the coil; and finally, a distributor worked by hand, which sends the current to the various sets of burners in rotation. The batteries consist of four couples 20 inches high, connected together by means of two thick copper conductors. There is a special arrangement for preventing the possible accident of the current not being cut off by the attendant; the apparatus is placed in a kind of press or cupboard, which is closed by a sliding door, and when the latter is shut it strikes down the lever of the contact breaker mentioned above. A conductor from one end of the coil touches all the lustres; a second, from the opposite end, is attached to an isolated discharging rod, which the attendant holds in his hand. The distributor on which he operates consists of a slab of india-rubber, having eighteen metallic buttons, each connected by a wire with as many lustres. The conductors are formed of four copper wires with triple covering of gutta-percha, tarred cord, and india-rubber ribbon. They are supported by vulcanite (*Caoutchouc durci*) isolators, and at all places where they require to be covered over, the parts of the wire are enveloped in an additional casing of india-rubber, two millimetres in thickness. The actual illuminators are fixed on a small circular plate, which is placed on the gas-pipe, just below the burner; they consist of two pieces of thick iron wire, bent round above, so that their points, which are fitted with strong platinum wires about a quarter of an inch long, are exactly where the explosive mixture of gas and air is formed. The distance between the points is half a millimetre. All the illuminators of the same group are connected with one another, and with the conductors, so as to form a circuit with as many breaks as these jets. Standing in the current of air which feeds the burner, the iron wires are kept cool. When the gas is to be lighted, the operator turns it on and waits a few minutes, that the air may all be driven out of the pipes, places the coil in connection with the batteries, and touches the eighteen metal buttons of the distributor successively with his discharging rod. The whole of the burners are lighted in fourteen seconds. The apparatus has worked for two years without interruption, and the batteries have only expended three kilogrammes of zinc.

Formerly, in order not to interrupt the Assembly by lighting the house, the gas was burnt during the whole sitting, and although it was kept as low as possible, until required, it caused a good deal of heat, and vitiated the atmosphere; the cost of the wasted gas, too, was considerable, for the present arrangement is said to be more economical than the former by about £80 a month.

Protection of Buildings from Lightning.—A paper on "The Protection of Buildings from Lightning," by Professor J. Clerk Maxwell, was read at the Glasgow meeting of the British Association. It was as follows:—Most of those who have given directions for the construction of lightning conductors have paid great attention to the upper and lower extremities of the conductor. They recommend that the upper extremity of the conductor should extend somewhat above the highest part of the building to be protected, and that it should terminate in a sharp point, and that the lower extremity should be carried as far as possible into the conducting strata of the ground, so as to "make" what telegraph engineers call "a good earth."

The electrical effect of such an arrangement is to *tap*, as it were,

the gathering charge by facilitating a quiet discharge between the atmospheric accumulation and the earth. The erection of the conductor will cause a somewhat greater number of discharges to occur at the place than would have occurred if it had not been erected; but each of these discharges will be smaller than those which would have occurred without the conductor. It is probable, also, that fewer discharges will occur in the region surrounding the conductor.

It appears to me that these arrangements are calculated rather for the benefit of the surrounding country and for the relief of clouds labouring under an accumulation of electricity, than for the protection of the building on which the conductor is erected.

What we really wish is to prevent the possibility of an electric discharge taking place within a certain region, say in the inside of a gunpowder manufactory. If this is clearly laid down as our object, the method of securing it is equally clear.

An electric discharge cannot occur between two bodies, unless the difference of their potentials is sufficiently great, compared with the distance between them. If, therefore, we can keep the potentials of all bodies within a certain region equal, or nearly equal, no discharge will take place between them. We may secure this by connecting all these bodies by means of good conductors, such as copper wire ropes, but it is not necessary to do so, for it may be shown by experiment that if every part of the surface surrounding a certain region is at the same potential, every point within that region must be at the same potential, provided no charged body is within the region.

It would, therefore, be sufficient to surround our powder-mill with a conducting material, to sheathe its roof, walls, and ground-floor with thick sheet copper, and then no electrical effect could occur within it on account of any thunderstorm outside. There would be no need of any earth connection. We might even place a layer of asphalt between the copper floor and the ground, so as to insulate the building. If the mill were then struck with lightning, it would remain charged for some time, and a person standing on the ground outside, and touching the wall might receive a shock, but no electrical effect would be perceived inside, even on the most delicate electrometer. The potential of everything inside with respect to the earth would be suddenly raised or lowered, as the case might be, but electric potential is not a physical condition, but only a mathematical conception, so that no physical effect would be perceived.

It is therefore not necessary to connect large masses of metal, such as engines, tanks, &c., to the walls, if they are entirely within the building. If, however, any conductor, such as a telegraph wire or a metallic supply-pipe for water or gas comes into the building from without, the potential of this conductor may be different from that of the building, unless it is connected with the conducting-shell of the building. Hence the water or gas supply-pipes, if any enter the building, must be connected to the system of lightning conductors, and since to connect a telegraph wire with the conductor would render the telegraph useless, no telegraph from without should be allowed to enter a powder-mill, though there may be electric bells and other telegraphic apparatus entirely within the building.

I have supposed the powder-mill to be entirely sheathed in thick sheet copper. This, however, is by no means necessary in order to pre-

vent any sensible electrical effect taking place within it, supposing it struck by lightning. It is quite sufficient to enclose the building with a network of a good conducting substance. For instance, if a copper wire, say No. 4, B.W.G. (0·238 inches diameter), were carried round the foundation of the house, up each of the corners and gables, and along the ridges, this would probably be a sufficient protection for an ordinary building against any thunderstorm in this climate. The copper wire may be built into the wall to prevent theft, but should be connected to any outside metal, such as lead or zinc on the roof, and to metal rain-water pipes. In the case of a powder-mill it might be advisable to make the network closer by carrying one or two additional wires over the roof and down the walls to the wire at the foundation. If there are water or gas-pipes which enter the building from without, these must be connected with the system of conducting-wires, but if there are no such metallic connections with distant points, it is not necessary to take any pains to facilitate the escape of the electricity into the earth.

Still less is it advisable to erect a tall conductor with a sharp point in order to relieve the thunder-clouds of their charge.

It is hardly necessary to add, that it is not advisable, during a thunderstorm, to stand on the roof of a house so protected, or to stand on the ground outside and lean against the wall.

The Cause of the Aurora.—In 1872 Herr Groneman, of Gröningen (Holland), propounded a new theory of the origin of the aurora, which he afterwards developed at great length in the *Astronomische Nachrichten* for October, 1874; and he has now, in the same journal, extended it so as to account for the geographical distribution of the aurora. According to this hypothesis, there are streams of minute iron particles circulating round the sun, like the well-known meteor streams, and these, when they come near the earth, are attracted by its poles, and form filaments stretching out into space, in the same way as iron filings sprinkled on paper arrange themselves in lines under the influence of a magnet underneath, each particle attracting the next by virtue of its induced magnetism. Herr Groneman, then, would refer the phenomenon of the aurora to the ignition of this cosmical iron-dust in its passage through the air, the distinction being that, on account of the filamentous arrangement of the particles in the direction of the dipping-needle, streamers are formed which, by an effect of perspective, appear to radiate from a point in that direction, and therefore nearly overhead. It is necessary to suppose that this meteor-stream is travelling nearly in the same direction as the earth, and Herr Groneman enters into elaborate calculations to show that the velocity of the particles would not be too great to permit the magnetic attraction to form filaments of 200 metres in length.—*Academy.*

XI.—CHEMISTRY.

The Chemistry of Rain.—The presence of peroxide of hydrogen in rain has been detected by various chemists; in snow by Struve; and in rain, snow, and dew, by Houzeau. Em. Schone finds that rain falling in large drops is richer in it than is drizzle. Prolonged rain shows a sensible decrease in the quantity; but the accompaniment of electric discharges is not found to produce any perceptible difference. The polar current brings rain poorer in this constituent than the equatorial.

Ozone in the Air.—The determination of the quantity of ozone in the air has not yet been achieved by any convenient method, since the tint of the ordinary ozone test papers is determined by the velocity of the wind. It was supposed by Von Pettenkofer that the absence of the ozone reaction in the atmosphere of closed dwelling-rooms was due to the slight circulation in the air. This subject has, however, been fully investigated by Wolffhugel, who finds that, while a given quantity of fresh air yields a very visible ozone reaction, yet ten or twelve times that quantity taken from the interior of dwellings produces no effect, even when the rooms are unused, having previously been well aired. Wolffhugel has also shown that there is a great absence of ozone in the air near the ground.

Eccentricities of Camphor.—When small pieces of camphor are placed on the surface of water they turn about with the most capricious movements. This phenomenon has been studied by M. Lescœur (of the Chemical Society of Paris) in a number of other bodies. He arranges in two classes the substances that are endowed with the "epipolar" force:—"1. Substances insoluble in water: when the spreading out has occurred, all movement is arrested, and the movement of any other body is suspended (fixed oils, fatty bodies, &c.). 2. Substances soluble in water: the superficial layer produced is dissolved or volatilised with more or less rapidity; the movement is continuous. The saturation of the liquid, and of the surrounding atmosphere causes all action to cease (camphor, acetic acid, essential oils). The phenomenon is one of capillarity, or of the superficial tension of liquids."

Watering the Streets on Chemical Principles.—In the manufactories of pyroligneous acid at Rouen large quantities of chloride of calcium were for a long time lost. Of recent years it has been sought to utilise the substance in watering the streets of Rouen, and this has been attended by the best results; so that M. Houzeau now proposes that the method be adopted for the busy streets of Paris. Watering the streets with chloride of calcium impregnates the ground with a hygrometric matter, which makes durable for a week the moisture communicated to it. Winds raise no dust on such ground. This watering, further, is wholesome, for the chloride from these manufactories always contains a good deal of chloride of iron and of tarry matter, which, being volatilised, has a beneficial hygienic influence. The method also realises an economy of about 30 per cent. on that in which pure water is used. For a period of six days the watering of a street

surface of 5,000 metres is estimated to cost, with pure water (furnished gratuitously), 60f., with chloride of calcium 40f., showing a difference in favour of the latter of 20f. And the advantage is that the chloride materially improves the roads, by covering them with a sort of patina or hard superficial crust of 1 to 2mm. thickness, which opposes a strong resistance, not to drying, but to disaggregation by vehicles, &c.—*English Mechanic.*

Dynamite.—A powerful explosive, the invention of a Swedish chemist of the name of Nobel, is at once the most powerful and the safest explosive with which we are at present acquainted. It consists of a paste made of certain proportions of a kind of rottenstone and nitro-glycerine, a very dangerous liquid explosive obtained by the action of nitric acid on ordinary glycerine. The earth renders the nitro-glycerine perfectly safe without interfering with its explosive powers. For instance, boxes of dynamite have been thrown from a great height without exploding, and if thrown on the fire it simply burns away slowly; it is therefore infinitely safer to transport than gunpowder. The evidence given before the Parliamentary Committee of the House of Commons, by several of the most noted scientific men of England was unanimous on this point. Practical men are unanimous in declaring that, as compared with gunpowder, only a fourth or fifth of the quantity of nitro-glycerine is necessary to produce the same effect.

Making War against Field Mice.—According to Dr. Nessler, cartridges recommended for destroying field mice by fumigation may be prepared by dissolving 12 parts of saltpetre in 24 parts of hot water, and mixing well with it 80 parts of sawdust, and 7 parts of coal-tar, and drying in the air. This powder may then be made up with starch paste (10 parts of starch to 90 of water) into a mass that can be formed into rods about 0·4 of an inch thick and 1 inch long, which should be well dried and sprinkled with melted sulphur. The mixing of the powder and making up of the mass with starch paste is readily accomplished in a petroleum barrel, containing 10 to 12 one-pound iron balls, and capable of being rotated on an axis passing through it lengthwise. The rods may be formed most rapidly by pressing the mass in sheet-iron moulds, having a number of compartments of the proper size. Several thousand, it is said, can be made by a practised hand in an hour. After drying they should be spread out, and by means of a broom sprinkled with fused sulphur.

How Iron Rusts.—It has usually been supposed that the rusting of iron depends principally upon moisture and oxygen. It would appear, however, from Dr. Calvert's experiments, that carbonic acid is the principal agent, and without this the other agencies have very little effect. Iron does not rust at all in dry oxygen, and but little in moist oxygen, while it rusts very rapidly in a mixture of moist carbonic acid and oxygen. If a piece of bright iron be placed in water saturated with oxygen, it rusts very little; but if carbonic acid be present oxidation goes on so fast that a dark precipitate is produced in a very short time. It is said that bright iron placed in a solution of caustic alkali does not rust at all. The inference to be derived is, that by the exclusion of moist carbonic acid from contact with iron, rust can be very readily prevented.

The Utilization of Sewage.—A paper was read before the British Association, by Mr. U. C. Sillar, "On the Utilization of Sewage." By utilization, he meant utilization. Throwing it into the sea was dispo-

sal, but not utilization; treating by lime destroyed the manure and spoiled the water; filtration, subsidence, or simple precipitation, clarified partially the water, but in no way utilized the dissolved impurities, which it was now well known contained the principal fertilising elements found in sewage. To effect this, these dissolved impurities have to be collected, and this was well done by the purification process of the Native Guano Company. Treatment by charcoal, blood, and clay collected these previous to precipitation, and it was this peculiarity that accounted for the extraordinary fertilising power of native guano over the sewage deposit after treatment, without the previous purification. There was now overwhelming testimony as to the agricultural power of native guano; and as the cost was moderate, the process inoffensive, and its adoption solved at one and the same time the two grand problems of rendering our waters pure and our land more productive, he trusted the good sense of the community would see the advantage of it.

Novelties in Chemical Apparatus.—In the *Moniteur Scientifique* for January M. Guerout gave an account (with drawings) of various recent improvements in chemical apparatus, including a frisette with continuous jet, a burette, a flask for fluorhydric acid, a siphon for poisonous and corrosive liquids, a densimeter, a blow-pipe, a tube for mixing liquids in absence of air, an improved Bunsen burner, a bellows for water, &c. The new blow-pipe is for persons who have difficulty in acquiring the play of the facial muscles which is required for giving a continuous blast. On a vertical support slides the metallic reservoir with jet, and to this reservoir is attached a caoutchouc tube, with glass or bone mouthpiece; while there is connected with the reservoir behind a small balloon of thin caoutchouc (like that used by children), inclosed in an envelope of white metal to protect it against sparks, &c. A small valve at the entrance of the tube prevents the air from escaping through it.—*World of Science.*

Artificial Ozone.—In order to produce artificial ozone, Mr. Lender makes use of equal parts of peroxide of manganese, permanganate of potash, and oxalic acid. When this mixture is placed in contact with water, ozone is quickly generated. For a room of medium size two spoonfuls of this powder, placed on a dish and occasionally diluted with water, would be sufficient. The ozone develops itself; it disinfects the surrounding air without producing cough.—*Medical Press.*

Protosulphide of Carbon.—Chemically, as is well known, oxygen and sulphur greatly resemble each other. The sulphide of carbon, however analogous in properties and composition to carbonic acid, has hitherto been considered the sole sulphuretted compound of carbon. M. Sidot has recently made the important discovery of protosulphide of carbon, which compound he obtains by subjecting bisulphide of carbon to sunlight; when the liquid undergoes a profound decomposition. Half of the sulphur separates to be again dissolved in the bisulphide not yet altered, and at the same time a black powder is precipitated, which is the protosulphide sought for. This, washed and purified, is destitute of taste or odour, and is absolutely insoluble in neutral solvents. Acids act upon it, giving rise to more or less complex products.

About Hydrogen.—M. Filhol, Professor at Toulouse, proposes hydrogen to act on arsenic by means of zinc and caustic potash, and not by zinc and diluted sulphuric acid, as has always been customary in the Marsh apparatus. Arseniuretted

hydrogen is really given off in this way, but if the same process be tried with antimony compounds, not the least trace of antimoniated hydrogen goes off. It is thus possible that in the case of a mixture of arsenic and antimony to disengage all of the arsenic, leaving the pure antimony behind. It is worthy of notice that when hydrogen is evolved by action of zinc—or, still better, aluminium—on caustic potash, if phosphorus be present, the colour of the ignited gas will be a beautiful green. The least trace of phosphorus can in this way be detected.

A New Test Paper. — Dr. Waller has prepared a new test paper by soaking strips of white paper in a solution of coralline. It is exceedingly sensitive to the action of alkalies, which turn it a beautiful red even in dilute solutions. Acids turn it yellow, but as the action is less striking, Dr. Waller proposes to use the paper only for alkalies, as a substitute for red litmus.

A Simple and Safe Experiment.—The following lecture-experiment, for demonstrating the explosion on ignition of a mixture of oxygen and hydrogen gas, is recommended by M. Rosenfeld (in the current number of *Poggendorff's Annalen*) as being at once simple and safe. Through a ball-pipette (diameter of tube 8mm., that of ball 3cm., point about 5 cm. from ball, and other arm 15cm. long) hydrogen is allowed to flow, the wider end being brought to the pointed tube by which the gas issues from a vessel in which it is being made. When the air has been forced out, the streaming gas is lit at the point of the pipette, then the latter is carefully removed from the outflow pipe, and held vertically with the point downwards. The hydrogen burns for a few seconds quietly, but, at the moment of extinction, the gnition of the oxy-hydrogen gas in the ball takes place with a pretty strong explosion, without, however, the ball suffering injury. If the experiment be made in the dark, a light phenomenon is perceived at the moment of explosion, filling the tube and extending a little beyond at the two openings. The same pipette may be used to explode a mixture of sulphide of carbon vapour and oxygen. The internal surface is first moistened with a few drops of the former substance, oxygen is passed through from a gasometer, the pipette is quickly removed, and the point of it, directed slightly downwards, brought quickly into contact with a flame. A pretty strong explosion follows, but one that is also without danger.—*English Mechanic.*

Sanitary Carbon. — Some interesting experiments were made about the middle of May at Campbell's Sewage Works, Wandsworth Road, with a new substance, which is practically animal charcoal, and which will probably find extensive use at no distant date in purifying the effluent water of districts that treat their sewage by precipitation, in clarifying the waste water of dye-works and mines, and the thousand and one other ways that will suggest themselves at once to persons conversant with sanitary matters.

It is the product of a company that owns some 1,200 acres of the district on the Dorsetshire coast where the famous Kimmeridge shale deposit is found. This is a deposit which is of undoubted animal origin, and is supposed to consist of blubber fish and other forms of marine animal life. However this may be, the shale is found to yield more plentifully than cannel coal, and at less expense, an excellent carbon ; 1 ton of the shale, after giving off 9,000 cubic feet of gas, leaving a considerable residue, which is the sanitary carbon in question. This substance is found to have precisely the same properties and action for all sanitary

purposes as animal charcoal that costs from 14*l.* to 18*l.* per ton, and the company hope to be able to produce it for one-fourth the price.

The experiments referred to consisted in treating some of the sewage taken direct from the sewer which runs under the premises and running it through a layer of the sanitary carbon, when the effluent water came out as clear as crystal. A more crucial trial still was made by mixing sewage with a compound of ink dye stuffs in solution, forming a liquid more intractable than would ever be met with in drainage operations; but the result was the same, the water running off perfectly clear, with no perceptible odour, and, as certain enthusiasts declared who went the length of tasting it, with no flavour. The results were certainly very striking.

Pure and Impure Air.—Mr. E. M. Dixon, Glasgow, at the meeting of the British Association, described an apparatus for the analysis of impurities in the atmosphere. In this machine aspiration of the air is obtained by means of a pair of air-pumps, the piston-rods of which are connected with a beam to either end of which the working handle can be attached. The air-pumps are connected directly with a reservoir of about the capacity of eight cubic feet, and this reservoir again communicates with the atmosphere by six comparatively small tubes. Hence the working of the pumps gives rise on the one hand to a somewhat intermittent flow of air out of the reservoir through the pumps into the atmosphere, and on the other hand to a regular flow of air out of the atmosphere through the six tubes into the reservoir. The function of the reservoir is therefore simply to secure a steady flow of air in the direction of the pumps, notwithstanding their necessarily intermittent action. The air thus set in motion in several distinct streams towards the pumps is, before it reaches the reservoir, first freed from the impurities in it by washing, and then measured as it passes through dry gas meters.

The machine, Mr. Dixon went on to say, had been in regular use for some time, and had given results regarding the presumably very pure air prevailing in the district around the Mull of Kintyre that, so far as they have been worked out, appear to be quite reliable. Mr. Dixon had had the opportunity of satisfying himself that the amounts, both of ozone and ammonia, were remarkably constant when the weather was dull and a fresh breeze was blowing either from the east or the west, while warm weather, accompanied with light winds, had the effect of more than doubling the amount of ammonia prevailing at other times, and when the amount of ammonia was exceptionally high that of ozone was exceptionally low.

A satisfactory estimation of neither ozone nor ammonia could be usually had from much less than 100 cubic feet of air, and about 12 hours were spent daily in drawing that amount of air through the liquids. These facts would not appear surprising when it was known that on an average of 16 days the amount of nitrogen existing as ammonia in 100 cubic feet of air was only the fiftieth of a milligramme, while the average amount of ozone existing at the same time in the same quantity of air was found to be less than one-twentieth of a milligramme.

XII.—WEIGHTS, MEASURES, AND TIME-KEEPERS.

Measuring Distances and Heights.—Our Boston correspondent writes:—"May I mention an ingenious instrument which I had the pleasure of seeing the other evening, and hearing explained by its inventor, Mr. Edward O. Pickering, professor of physics in the Massachusetts Institute of Technology. It is designed for measuring the distances and heights of mountains. It consists of a common telescope, with a level attached, a scale of equal parts in the eyepiece, and with a mirror of plate-glass fastened to the object, so that it can be seen at any angle. Two images are seen, one through the glass, and the other by reflection from its surface, and any two objects may be made apparently to coincide by turning the mirror through the proper angle. Selecting as our object the mountain whose distance is to be measured, and as the other any convenient, well-defined point, the telescope is moved through a known distance, and the apparent change of position of the two images is measured by the scale. From this the distance may be determined with all the accuracy needed for an ordinary map. It is, in fact, equivalent to the *stadia*, with the advantage that an assistant need not be sent up the mountain to be measured, and with the same accuracy that would be attained if he could carry a pole a hundred or a thousand feet long. The altitude is then determined by levelling the telescope and reading the apparent elevation from the graduated scale which is now turned round. By a second inclined level, higher mountains may be measured. It will probably equal in accuracy a large theodolite with the advantage that it does not involve a finely graduated circle or delicate mounting. It is therefore inexpensive, light, and easily used. It could be carried by any traveller, and would give the height of a mountain much more accurately than a barometer. Further, a whole range of mountains might be measured in a few hours by this instrument, while with the barometer a single ascent often occupies several days."—*Academy.*

Metric Weights and Measures.—Mr. James Heywood, at the meeting at Glasgow of the British Association, read the report of the committee which had been appointed some years ago on the subject of "Metric Weights and Measures." He explained that they had had a very excellent representative in Parliament—Mr. William Ewart, member for Dumfries. He brought a bill into Parliament on this subject, with the view of giving the metric system a legal position in this country. That bill was carried, but it was not complete. There was one point which it wanted, and that was, that suppose a British tradesman sold, say silk, by the metre, if the money were not paid, he had not the power to recover it. A clause ought to have been put in to allow a metric legal standard, and to allow a tradesman selling in the French way to recover for debts contracted in this way. Since that time Mr. Ewart died, and the member for Stockport had charge of the measure, but it had never passed, and what they wanted was to impress on the members of the House of Commons who had sufficient interest in the matter to take it up,

and pass a law to allow the merchant who weighed or sold goods according to the French system to recover where not paid. The report, which was drawn up by Professor Leoni Levi, urged on the friends of education in Parliament the use of the most efficient means for the restoration of the clause in the Educational Code providing that "in all schools the children in standards V. and VI. should know the principles of the metric system, and be able to explain the advantage to be gained from uniformity in the method of forming multiples and sub-multiples of the unit."

The President (Sir G. Campbell) expressed his approval of the recommendations made by the committee. He regarded the decimal as a most inconvenient multiple, because ten was the least divisible of all numbers that could be used. If the figure proposed had been eight or twelve he believed that a uniform system would be much more readily adopted throughout the world. He thought that the time was not far distant when the suggestions made as to uniformity of coinage, as well as weights and measures might be carried out to this extent, that the American dollar might be made so uniform to our coinage as that five dollars should go to the £1, and if five francs to the dollar could be adopted another important step would be effected. By putting a little more silver into the Indian rupee he thought we could also establish a uniform system of ten rupees to the £1. If these general principles were established, we might leave the subdivisions and multiplications to the taste of different countries.

New Standards Wanted of Measure and Weight.—A paper "On New Standards of Measure and Weight," was read by Professor Hennessy at the Glasgow meeting of the British Association. Owing to the objections many persons still entertain to the metric system, the author brought forward for consideration the standard which he had proposed several years since, and which had been advocated by the late Sir John Herschel. The standard of measure is a bronze prismatanic scale, which is the fifty-millioneth part of the earth's polar axis. From this a system of weights is derived by taking a fraction of the standard of length as the side of a cube and finding the weight of an equal volume of distilled water. In this way a series of weights were constructed in bronze; a chain containing 50 links, each equal to the bronze standard, was also constructed, and this chain was therefore the millionth part of the earth's polar axis. The link or standard scale measures very nearly 10·0097 English inches, and its tenth part was, therefore, very little in excess of 1in. This, as well as the geometrical superiority of the axial standard over one derived from any meridian seemed to have influenced Sir John Herschel and others in preferring it to the meter. Professor Herschel made some remarks, and the author then explained the manner in which the standard of weight was derived from that of measure. The temperature at which the latter was taken was 15 deg. C., or a little more than 59 deg. Fahrenheit. Geodesical measurement had, in fact, shown that the earth is a somewhat irregular spheroid, and therefore that its meridians are unequal, while the polar axis is necessarily unique and corresponds to every meridian. On these grounds, Prof. Hennessy thought that the new standards might be universally accepted by all nations if the objections to the meter should continue to prevent its general adoption. It was stated that the standards of measure and weight referred to were exhibited in the Loan Collection of

Scientific Instrnments at South Kensington.

The Westminster Clock.—Sir E. Beckett delivered a lecture in November to the members of the Horological Institute in the clock-room of the tower of Westminster—the subject being the peculiarities of the great clock. The dial, Sir Edmund stated, is 22 ft. in diameter; its area is exactly 400 square feet, and the fall of the weight is 175 ft There is no other dial with minute hands of that size in the world. There is a larger dial of 40 ft. diameter in Mechlin, but it has not the minute hands. Here there are four of these dials and four minute hands to work. The clock has what is called a gravity escapement, which was invented by him, and has now become common in large clocks.

There are five bells for chiming the quarters and striking the hours. The largest bell weighs 13½ tons, and the others are of the respective weights of 4 tons, 30 cwt., and 20 cwt. The largest bell has unfortunately got a crack in it, but the same thing which caused the crack prevented its going through. In the metal there was a mixture of tin which did not amalgamate, and the consequence was that the outside was harder than the inside, and the result was that the bell cracked, but the crack did not go through. The weight of the hammer was 4 cwt. It ought to weigh 8 cwt., and until the bell cracked, the hammer which was in use did weigh 8 cwt., and the reverberation of the bell was in consequence then much louder. But the lifting of a hammer weighing 4 cwt. was no joke, and there was nothing like it in the world that he was aware of.

The winding up of the going part takes ten minutes, but the winding up of the striking parts - the quarter part and the hour part—takes five hours each, and this has to be done twice a week. The contract cost of winding up the clock is £100 a year.

The error of the clock amounts to only one second for 83 days in the year, and there is no other clock in the world of which the same may be said. It was commonly supposed that the clock was kept right by galvanic action with the Observatory at Greenwich, but that is not so. What it does is this—it reports itself at Greenwich twice every day, and there are return signals. The weight of the pendulum is 680 lb. and it can be accelerated a second a day by putting on an ounce weight.

The Distance-measuring Wealemefna.—Mr. Edward Russell Morris, of Birmingham, is much happier in his inventions than in devising names for them. He has just constructed a most useful pendant to the watch-guard, which he calls the wealemefna, or watch-chain measuring instrument. It will do the work of both rule and measuring-tape, and will measure with accuracy minute fractions of an inch or the length of a room. To measure any object it is simply necessary to run it over the surface, when the distance is at once indicated by the hands, the large hand registering the inches and fraction of an inch and the small hand the feet. The wealemefna is also useful for measuring distances on maps, however wandering the routes may be. This handy little instrument, which may also be attached to a watch-guard or chatelaine, or kept in the waistcoat pocket, can be obtained of opticians and jewellers.—*Illustrated London News.*

A Complaint about Pints and Quarts.—The Warden of the Standards has occasion again to advert to the subject of bottles. Six years ago it was represented to the Standards Commission that wine and ale bottles, commonly known as reputed quarts or pints, were getting smaller, and held less by two or three wine

glasses than they did thirty years previously, and it was suggested that the quantity of their actual contents should be stamped upon them. But the commissioners considered that they could do no more than recommend the legalisation of a standard bottle and half-bottle measure, containing a sixth and a twelfth of a gallon respectively, and thus give the public the means of ascertaining that they got their proper quantity. Accordingly, the Warden of the Standards verified standards of these measures in 1870, and he now reports that he reverified them in 1875. But he has to state that these newly legalised measures do not appear to be much used. In the whole of the last four years not quite a hundred bottle and half-bottle measures have been verified for the use of local inspectors of weights and measures; only two in the last year.

Improved Weighing Scales.—Improved weighing scales have been invented by Henry M. Weaver, Mansfield, Ohio. The invention consists in the direct application of the platform-carrying and weight-supporting knife edges to separate weights of different proportions. These weights are jointed by arms and pivot-rod, so that the result is obtained of allowing the object to be weighed being placed upon any part of the platform; and also the weights, having to each other quicker and slower oscillations, tend to stop each other, and thus bring the index sooner to a rest. The casing is provided with an adjustable device for setting the index to the zero point of the stationary dial. To one or each of the weights is attached one or more smaller weights, which, being adjustable, can be used to increase or decrease the capacity of the scale, and also adapt it to any given dial plate.

The Centennial Clock.—The clock that went from Thomastown, Connecticut, to the Centennial contained 1,100 pieces, and weighed 6 tons. The main wheels measured 4 ft. in diameter. The pendulum ball and rod weighed between 700 and 800 lb., the rod being 14½ ft. long, and making two second beats.

Time-keeping Behind the Age.—According to a letter published in the *East Anglian Times* of Nov. 24, it would appear that the Corporation of so important a town as Ipswich still authorises the use of local mean time within its liberties, and the business of the place is actually regulated by its edict. Railway time has there a distinct meaning, being 4 min. 40 sec. later than that in general use. We believe that Norwich is in an equally unscientific state as regards time-keeping. It is quite time that an end was put to this absurdity, and we hope some pressure may be brought to bear upon the authorities to effect the long-delayed and desirable introduction of the now almost universal Greenwich time.—*Nature.*

XIII.—DOMESTIC NEWS.

A New Use of Seaweeds.—Another attempt on the part of ladies to be self-helpers demands a brief record. A Miss James has conceived the idea of converting seaweeds into the semblance of graceful flowers by certain aids from colours, and by an ingenious moulding of natural forms. Seaweeds, dried, have long been favourites in albums, and few who spend an autumn month at marine localities neglect opportunities of gathering and preserving them; but to wear them in hats or caps, or as hair ornaments, is, we believe, a novelty—at least, until now, we have never seen an effort of the kind. It is not easy to describe the effect Miss James produces. At a distance the seaweeds seem artificial flowers made from muslin or wax; examined nearer they are very striking. Sometimes there is added to them the sparkle of small shells. If some lady leader of fashion would wear a group or two she might introduce a new and very graceful mode of employing ladies, doing a large amount of good and no harm, and aiding to abolish an atrocious custom—that of destroying beautiful birds in order to obtain means of decoration. A lady who adopts and supports that evil practice should find it difficult to be selected as a wife.—*Art Journal.*

Warm Feet in Winter Weather.—An amusing chapter might be written on the eccentricities of inventors. In a recent number of the *Patent Journal* the particulars are specified of an extraordinary contrivance, which is a combination of foot-warming apparatus with a boot. The heel of the boot is of metal and hollow, and contains a supply of artificial fuel, the heat from which is made to pass through channels in the inner sole, a portion of which is placed upon a spring, so that the action of the foot in walking acts like a bellows, drawing in the cold air by an aperture in the heel and driving the heated air into the boot. A modification of the apparatus can, we are told, be applied to horse-shoes. A little further stretch of invention on the part of the ingenious Laputan who invented . and we might expect to see the steam-leg and the seven-league boot transferred from the region of fiction to that of fact.—*Iron.*

How Black Hair may be changed to a Golden Yellow.—Professor Schrötter of Vienna examined carefully the high-priced cosmetic recently introduced by Thiellay of London for changing the colour of black hair to a golden yellow. He recognised in it simply a dilute peroxide of hydrogen, prepared with well water, and which owes its permanence to the great degree of dilution and the presence of a small quantity of free acid, most probably nitric acid.

A Darning Machine.—What has been long thought impossible has been achieved by the inventive genius of our American cousins, that is, to darn by machinery. The darning machine answers its professed purpose in nearly every practical particular. All the tedious processes of darning by hand are repeated by the machine; only, instead of one needle, the machine uses fourteen, and each needle carries two threads. Thus, while the hand needle draws in only one thread, the machine, at the single turn of the

handle, conveys fourteen threads through the portion of the stocking required to be mended, which is secured between two corrugated plates visible in the middle of the front pistons. The process of threading the fourteen needles is very simple, and other preparations are not required before setting the machine at work. The whole contrivance is, indeed, so simple in construction that its use can be learned in five minutes, and of such substantial build that a getting out of order seems an impossibility—the more so, as broken, bent, or rusty needles, the only accidents we can think of, can easily be replaced. Heels and toes of stockings, as well as any other parts of knitted or worsted garments, can be darned or thickened upon this machine in the most effectual manner. Of course ornamental darning must not be expected; but anybody who does not care for the somewhat unsightly appearance of an ordinary darn, will find the work of the machine perfectly satisfactory, and a great saving of time and temper.—*Queen.*

The following description of the darning machine is given by an American paper:—"Imagine a little apparatus infinitely more simple than the sewing machine, which repairs the hugest darn in much less time than we can describe the operation, and far more neatly than you can do it with all your years of practice. This is what it is. Two small plates, one stationary and the other moveable, are placed one above the other. The faces are corrugated, and between them the 'holy' portion of the stocking is laid. Twelve long eye-pointed needles are arranged side by side in a frame, which last is carried forward so that the needles penetrate opposite edges of the hole, passing in the corrugations between the plates. Hinged just in front of the plate is an upright bar, and on this is a crosspiece carrying twelve knobs. The yarn is secured to an end knob, and then, with a bit of flat wire, pushed through the needle eyes. Then the loop between each needle is caught by the hand and hooked over the opposite knob, so that each needle carries really two threads. Now the needles are carried back to their first position, and in so doing they draw the threads, which slip off the knobs through the edges of the fabric. A little push forward again brings the sharp rear edges of the needle eye against the threads, cutting all at once. This is repeated until the darn is finished, and beautifully finished it is. The inventor is Mr. O. S. Hosmer, of Boston, and we predict for him the blessings of the entire feminine community. The cost of the machine is but ten dollars."

Danger in Cooking Vessels.—The thanks of every good housewife, as well as every one who has the good fortune to be catered for by such, are due to Mr. Tatlock, the analytical chemist, for the pains he has taken (says the *Glasgow News*) to demonstrate the dangers that lurk in enamelled cooking utensils. It is a common and very natural belief that vessels lined with a substance not distinguishable by the ordinary eye from porcelain are perfectly safe for all kinds of cooking. Mr. Tatlock finds that while this is true of some, made by certain manufacturers, it is the very reverse of the truth as regards others. In the *Sanitary Record* for September the 23rd will be found his analysis of three samples of the so-called porcelain. Without going into chemical details, it is enough to say that two out of the three contain very large quantities of lead, one as much as 25 per cent. of its weight. This lead is in an uncombined, or feebly combined condition, and is liable to be dissolved by very feeble acid solutions. There is probably no fruit except strawberries that would

not dissolve it freely, and there can be little doubt that even water boiled in the vessels would take up a quantity quite sufficient to injure health. In addition to this, one of the samples contained over one per cent. of arsenic, another nearly a half per cent., and the third a mere trace, or, to be accurate, 1-50th per cent. Mr. Tatlock would add to the favour he has conferred upon the public if he would tell us which manufacturers avoid these dangerous ingredients.

Notes on Table-Napkins.—Some table-napkins and cloths were lately brought to Prof. Birnbaum, of Carlsruhe, for examination, which, after one and a half years in hotel use, were become very brittle and easily torn. Under the microscope the threads appeared much incrustated with a substance which proved to be carbonate of lime. The texture gave 8 per cent. ashes, consisting almost entirely of calcic carbonate. This was evidently the source of the evil. In use of the cloths the mineral substance had acted as a grinding instrument. Dr. Birnbaum next inquired whether the substance was originally in the linen or had been introduced by the purchaser. He got from the manufacturer linen yarn and plain linen which had been made at the same time as the linen in question, and found the ashes of the yarn to be 0·32 to 0·34 per cent.; those of the plain linen 0·38 per cent. This clearly pointed to the purchaser. He affirmed that he used no chloride of lime in washing (a substance which might possibly have deposited lime on the fibres). Prof. Birnbaum happened to observe that in many hotels the napkins were freshened by moistening with lime-water and pressing. The thin coating of lime thus imparted to the texture a hard feeling, and a certain finish, and napkins, after this treatment, might easily be taken for newly washed. By repeated treatment of this kind the napkins may quite acquire the properties of those which had been rendered useless; and it is very probable that in this way the large quantity of lime had been acquired by the fibres of the cloth. Any such use of lime-water should be carefully avoided. It is a known fact that in the fibres of tissues any crystals which may form rupture the cells of the fibres. And lime-water gives rise to a crystallising-out of hydrate of lime in the texture. This can directly weaken the strength of the threads. In air it soon passes over into carbonate, and enlarges in volume, so that a further destruction of the fibres takes place. Lastly, the calcic carbonate may act in the grinding way above indicated.—*English Mechanic.*

The Chandor Lighting Apparatus.—At a recent gathering at Edinburgh, Professor Archer drew attention to a new invention—the Chandor light. The apparatus is, in outward appearance, a small tube three or four inches long, having at one end a revolving button, which turns a screw, and at the other minute angular point of metal, which also revolves, passing over a little orifice in the closed head of the tube. A continuous tube, formed of a delicate strip or solidified collodion, with a ridge of hardened phosphorus on one of its sides, is slipped into the tube, and, once in position, can be moved upward by the screw. By the same action which presses the upper end of the fuse against the opening of the top the metal point is turned against the phosphorus, and a small portion of the collodion is thereupon ignited. When the apparatus is fixed to a gas-burner, only a very transient flash is needed for the purpose of ignition, and not more than a seventieth part of collodion fuse is consumed in the operation. When, however, the wick of a lamp has to be lighted by the same means, a larger proportion of the fuse, the

thirty-second part in fact, is burned. The apparatus is either portable or adapted to the uses indicated. If a lamp goes out, it can be instantly re-lighted by a turn of the screw, instead of by opening the case, removing the chimney, and striking a lucifer match, thus affording a great advantage in cases where quantities of combustible material are lying about.

New Fire-lighters.—A method of utilising raw peat or turf has been found by Mr. William Cole, of Ilfracombe, who has taken out letters patent for the manufacture of instantaneous fire-lights from cheap, waste, and easily procurable combustible materials. The patentee takes turf, bog, or peat (generally from marshy and waste lands), and cuts it into cakes of about three inches in length by three inches in breadth, and about one inch in thickness, or it may be cut of any required size; it is then first dipped in mineral or vegetable oil, and then in pitch, tar, or resin, after which the cakes are wrapped in paper. The pitch, tar, or resin may or may not be mixed with coal or tallow. The proportions of the ingredients used will necessarily vary, as the fire-lighters are made of an uneven size, and consequently some will soak up more of the ingredients than others, but the precise proportions will readily be ascertained in practice; or the turf, bog, or peat may be ground and compressed with resin into suitable cakes, blocks, or pieces first, then dipped into the mineral or vegetable oil, and then into the pitch, resin, tar, or combustible material.

The patentee does not furnish any particulars of the method he employs to dry the peat, nor of the probable cost of his instantaneous fire-lighters. The great obstacle to the utilisation of peat has hitherto been the difficulty experienced in drying it, and the consequent expense.—*English Mechanic.*

Clockwork Traps for Flies.—By David S. Kidder, Turner's Falls, Massachusetts, assignor to himself and Frank W. Peabody, same place. —The flies alight upon a pan, which is rotated by clockwork, and which is separated by partitions into three divisions. Gates are hinged to the side of the platform, from which the pan passes to cut off the escape of the flies in that direction. Said gates rise to let the partitions pass, and have vertical plates, so that they close progressively, and prevent any opening at the outer part of the pan. Directly behind the gates is a covered way leading into a light chamber, through which the flies are crowded by the partitions as they advance towards the gates.

Not at Home.—The New Year's receptions in the United States have led to a novel but somewhat useful custom. Most journals in the provincial towns contain on the previous day a list of the ladies who will be at home for the receptions, while in another column are the names of those who are prevented from receiving by sickness, absence, domestic affliction, &c. This prevents a great loss of time and trouble to those whose acquaintance is numerous.—*Graphic.*

Paper Egg-cups.—Mr. R. M. Washburn, of Burlington, Iowa, has patented a paper egg-cup, which, besides being a really ingenious idea, is based on sound theory, inasmuch as paper is a non-conductor of heat; it is elastic, so that one cup will hold securely an egg of any size; and it is moulded in corrugated form, so that there is always a circulation of air between the egg and its vessel. The same cups may be used over and over again, or may be thrown away after each meal, their cheapness allowing of this latter disposition. They are handy for pic-nic parties or for persons travelling, and as novelties for hotels, restaurants, and even pri-

vate houses. The material may be paper, muslin, or almost any fabric. Tinted of different colours, the cups would be quite ornamental; or they might serve as a medium for advertising, so that the person using them may have food for digestion mentally as well as physically. The invention is one likely to be remunerative. It is just such cheap and simple devices which, now-a-days, are most in demand, and produce the largest profit.

Protection for Ear-rings.—An ingenious method of protecting valuable ear-rings when travelling has come into fashion across the Atlantic. Ladies buy little balls of gold, which open with clasp and hinges, and effectually enclose and conceal the precious stones.

Spotted Veils for Ladies.—Besides the disadvantage of making young ladies look as though they were just recovering from the small pox, spotted veils may exercise an injurious influence on the sight. If the fall retains its position steadily, there must be a perpetually unconscious endeavour to avoid the interposing obstacle to sight, offered by spots immediately in the line of vision. If these move, the subjective result is a ceaseless flickering of opaque points before the retina in a manner, whether or not distressing, certainly injurious. It is no use flying in the face of fashion, but it may be worth while to point out that the wearing of these unsightly face-screens is not free from danger. Here and there perhaps a more than commonly sensible young person may take warning, and escape the contingent possibility by discarding an ungraceful appendage.—*Lancet.*

Window Gardening.—In the beginning of July the lawn at Grosvenor-house was a pretty and interesting sight, for a children's flower-show was being held in the grounds. Troops of smiling little boys and girls covered the grass; a band was playing; the sun was shining; prizes were to be given away. The Duke of Westminster, hearing that there was to be a flower-show held in the parish, at once proposed to lend his own garden for the purpose. The tent in which the plants were placed for exhibition did not contain anything that was rare, nor even fine specimens of ordinary flowers. Nevertheless there was an interest attached to the straggling geraniums and dusty cockscombs not to be found in the finest display at the Crystal Palace. All the plants came from the narrow, hot streets and mews of the neighbourhood; all had been nursed by the little children who live there—little children who had perhaps never picked a cowslip in a meadow or seen a wild rose growing in a hedge. But they had done their best to bring some breath of the country into the noisy streets, among the depressing brick and mortar; and kind people wanted to help them and see what success they had had in their work. But it is not alone among the poorer classes that window gardening ought to be cultivated. We do not see why the children of the upper and middle classes should be without their flower-shows also. Why should not they too be encouraged to make gardening a pursuit? There are thousands of professional people whose families live the greater part of the year in a London street. Every window in such a street might be made to glow with beautiful flowers; nor would the assistance of the nurseryman be required if the denizens of the home nursery were encouraged to love gardening. As it is, they know little or nothing about flowers beyond the names of those they see hawked about the squares, and planted geometrically in the parks.—*Saturday Review.*

Mechanical Money-boxes.—Our American cousins are the inventors of some very ingenious money-boxes. One is in the form of a frog. You put a penny into its mouth; it gulps it down, and at the same time rolls its eyes about, as if swallowing coins were a very pleasant pastime. Another consists of a box with a slit attached to a miniature race-track. When the penny is dropped into the slit, two or three tin horses at once proceed to race round the track. A third represents a portly individual seated in a chair. The coin is placed in his hand, whereupon he pockets it in the most natural manner by inserting it in a slit placed in the position of a coat-pocket.

Precious Stones.—Mr. Ruskin delivered a lecture on minerals generally, but applying himself chiefly to precious stones, in the theatre of the London Institution, about the middle of February. Heraldry, he complained, was despised by modern science, but yet, as understood by our ancestors, it had a deep and important meaning. *Or*, or gold, which was represented by the topaz, stood between light and darkness; *ecarlate* was the sacred colour of the living flesh, as represented in the blush of the virgin and the flush of valour on the cheek of the young warrior. *Vert* was the green of the emerald, and *gules* was rose-coloured, from the Persian word "gul"; a *rose azure* was the clear, sacred blue of the sky, typical of the joys of heaven. The ruby and sapphire in combination produced the purpura, or purple, which formed the covering of the tabernacle. Out of the above colours came the combination of the rainbow. *Argent* typified the silver colour of the hoar frost, and *sable* meant sand, in which the diamond was always found. *Grey* was the colour of the pearl, and suggested humility; and thus all the phrases of heraldry which applied to colour and to precious stones, although now looked upon as jargon, had a deep symbolic meaning. At the close of the lecture, Mr. Ruskin advised the ladies to have all their gems set uncut, and he cited the ruby in her Majesty's crown as the most beautiful specimen of an uncut precious stone in the world.

A New Insecticide.—At a recent meeting of the Royal Horticultural Society, attention was called to a new insecticide, which consists of camphor dissolved in methylated spirits to saturation, and mixed with soft soap to the consistence of cream. When diluted so as to be fit for use with a syringe, this has been found an efficacious substitute for fumigation in the case of mealy bug, scale, red spider, &c.

"Umbrella-rig" for Ladies.—Mrs. Eliza M. Arnold, of Houston, Texas, has invented and patented an improvement in rigging ladies of any size, which greatly simplifies the task of setting or furling an umbrella. The new invention is called an "umbrella supporter," and next to the device of double topsail yards, it is probably the most important improvement in rigging which has been made during the last half century. Mrs. Arnold's description of the umbrella supporter is extremely interesting. Two curved rods made to fit upon what the inventor calls "the forward side," are fastened at the lower ends to the belt of the wearer, and, passing over her shoulders, unite behind the neck to form a socket, into which the foot of an umbrella is stepped. The socket resembles in appearance the truss of a ship's mainyard, with the important exception that it is made of steel twisted into spiral springs, so that free lateral motion may be given to the umbrella. The rods are furnished with back-stays leading to

the arms, and when these are set up taut, there is no danger that the rods will be carried away by a sudden squall. The umbrella is furnished with halyards and brails, so that it can be easily set or taken in, and it is trimmed to suit the direction of the wind or of the sun's rays by means of braces. It is claimed that the umbrella can be handled with extreme ease.

Cleaning Silks.—The following mode of cleaning silk garments has been successfully tested. The garment must first be ripped and dusted. Have a large flat board; over it spread an old sheet. Take half a cupful of ox gall, half a cupful ammonia, and half a pint of tepid soft water. Sponge the silk with this on both sides, especially the soiled spots. Having finished sponging, roll it on a round stick like a broom-handle, being careful not to have any wrinkles. Silk thus washed, and thoroughly dried, needs no ironing, and has a lustre like new silk. Not only silk but merino, barège, or any woollen goods, may be thus treated with the best results.

A New Button.—A button has been invented which requires no sewing on, and has a better hold than when sewn on, the strain not being simply in the centre, but diffused over the whole circumference of the disk, short of the rim. Not only can these buttons be put on without sewing, but removed quite readily, whether for washing the materials to which they are attached, or for altering their position. All that is required is to pierce the material with a bodkin, to pass through the aperture the shank attached to one face of the button, and then through the keyhole of the opposite disk, placed for the purpose on the obverse side of the material, a fastener by the groove being then slid on the shank, when it is closed by a spring. There is now an equable pressure over the whole surface of the cloth or other material covered by the button; and it is the area of the cloth so covered, and not the spring, which merely keeps the fastener in place, that maintains the resistance.

Borax as an Antiseptic.—Borax is said to have yielded good results in an investigation into its merits as an antiseptic. A saturated solution of boracic acid, with a small quantity of borax, salt, and saltpetre, makes a "brine" in which fresh meat is treated with so much success that it can be preserved untainted even in the hottest parts of the earth.

A Thorough Washing Machine.—This machine is the invention of Mr. W. Kirton, of Nottingham. It consists of a strong cast-iron steam-tight case, in which revolves a wire cage to contain the articles to be washed. This cage is divided longitudinally into compartments by perforated partitions. Superheated steam, boiling water, or cold water can be introduced into the apparatus by pipes communicating with the interior through the hollow axis which supports the cage. These pipes are so perforated that the steam or water is delivered upon every part of the fabric to be operated on. Thus, supposing the machine to be filled with sheets, blankets, or other articles, the lid is clamped down, and superheated steam is forced in from the engine boiler; afterwards hot water is introduced from the same source, and the steam being still admitted, the contents are well boiled, whilst the cage is made to revolve rapidly. By opening a stop-cock, the dirty water is drawn off (being completely expelled by the action of the steam), and cold water is introduced. The vacuum thus produced, together with the centrifugal action of the revolving cage, effectually rinses the clothing.

In the case of greasy materials, the inventor has prepared an ammoniacal soap, which he uses for the purpose of washing ordinary household linen, &c., and certainly the difference between specimens of articles washed by this machine and those "got up" by the washerwoman is very striking indeed.—*Lancet.*

XIV.—OUR FOOD SUPPLIES.

Nourishment for Brains.—There was once a gentleman who used to argue that the soul is seated in the pineal gland; and that there are special regions of consciousness in the brain, different parts of which have different functions, is a doctrine now establishing itself on what may be considered sufficient authority. Further investigation in this direction may avail to show what should be the remedy for an atonic or hypertrophied ideality or other function. Meanwhile we have the assurance of Mr. Frank Buckland, who has lately passed a brilliant examination on the *Ostrea edulis* before a House of Commons committee, that "brain power in those engaged in business and literary pursuits was greatly strengthened by phosphorus conveyed in the form of oysters." This assurance, although weighted with the statement that oyster-meat costs 9*s.* 4*d.* per pound, cannot fail to be of immense value to all those—not so large a class—who have need of their brains. Candidates for the Indian Civil Service, Newdigate prize poem men, common jurymen, and the holders of foreign bonds, will now, no doubt, eat, who never ate before; and City men, with whom, for their easy digestion, oysters are a favourite food, will eat the more. We cannot understand why "those engaged in business" should take precedence, in the repair of brain waste, of those engaged in literary pursuits, but can easily believe in the possibility of the proposal—a direct corollary to Mr. Buckland's assurance—that, as we have compulsory nurture of the mind, so we must have compulsory nurture of the brain. We wonder how much more luminous some of our most brilliant writers would have been had they but seen to a proper supply of phosphate of iron and osmazome.—*Iron.*

Diet for the Arctic Regions.—The following is the scale of diet adopted for each man attached to the Arctic Expedition under Captain Nares:—1 lb of biscuit every third day, and 1 lb. of flour for bread on each of the two intervening days; every other day 1 lb. of corned beef or corned pork alternately, and on the intervening days $\frac{3}{4}$ lb. of preserved meat and $\frac{1}{4}$ lb. of salt meat; every fourth day 1 lb. of compressed vegetables, and on the others $\frac{1}{4}$ lb. of preserved potatoes; $\frac{1}{2}$ lb. of preserved soup every fourth day; $\frac{3}{4}$ lb. of flour, suet and raisins every fourth day; $\frac{1}{4}$ lb. of split peas every fourth day, with $\frac{1}{2}$ oz. of celery seed to every 8 lb. of peas; 1 oz. of lime-juice, which every man is called upon deck to drink, each forenoon; 1 oz. of sugar for lime-juice, 1 oz. of pickles, and $\frac{1}{2}$ gill of rum daily; $\frac{1}{2}$ oz of mustard and $\frac{1}{4}$ oz. of pepper a week; 2 oz. of preserved fruit and $\frac{3}{4}$ oz. of sugar for fruit twice a week; and oatmeal, vinegar, and salt as necessary. It is further intended to add $\frac{1}{4}$ lb. of preserved meat on salt-meat days, so as to give some fresh meat for consumption every day, as the salt beef is hard and dry, and, if anything, enters too largely into the scheme of diet.—*Medical Press and Circular.*

Dishonest Dealings with Wines.—Fuchsine is often employed on a large scale to heighten the colour of wines and mask the addition of water. MM. Feltz and Ritter have lately studied the phy-

siological action of this substance, and found it seriously injurious both on the human subject and on dogs. A simple way of detecting the addition of fuchsine to wine has been described by M. Husson. Introduce a few grammes of the suspected wine into a phial and add a little ammonia. The mixture takes a dirty green tint. A thread of white wool (such as is used for tapestry) is then put into the liquid. After being well soaked, it is drawn out and fixed vertically, and a drop of vinegar or acetic acid is allowed to flow along it. If the wine be natural, as the drop advances, the wool will become pure white again. If it has been altered by fuchsine, the wool will take a rose colour more or less dark. The reaction is of the most distinct character. Thus one might even approximately determine the quantity of colouring matter added, a number of graduated specimens having been prepared beforehand.

Condensed Eggs.—The extent to which we are dependent for eggs upon our Continental neighbours is best shown in the Board of Trade returns, the value of eggs imported during the first eleven months of 1875 reached no less a sum than 2,426,806*l.*, representing, at an average price of 6*s.* per hundred, more than 800,000,000 eggs. The peasantry of France, Germany, and Austria make poultry culture a most profitable occupation, but the difficulty of transport and the heavy percentage of loss from breakage and decay combine to raise the price to the consumers. With a view to utilising in a more portable and consequently cheaper form the large supply of eggs obtainable by the Danube, an enterprising firm has recently started a factory at Passau, in Bavaria, for the purpose of condensing them. The eggs are carefully selected and dried, then reduced to a fine meal and packed in tins ready for use. They have been reported on by the highest authorities as a most valuable article of food, and their supply to the soldiers of the German army is now under consideration, as providing for a campaign the greatest amount of nutriment, whilst occupying the smallest space in the knapsack. The article is already finding its way into English consumption.

Alluding to this importation, the *Sanitary Record* remarks:—"There has been considerable talk of late respecting a factory established at Passau, Bavaria, for reducing dried eggs to meal, which, protected from the air, or rather from what the air contains, keeps fit for food for a long time. This is an old process. Mr. Walter Thurger, formerly surgeon at Norwich, now retired from the profession because of broken health, prepared egg-powder by drying eggs in a current of dry but cool air, and reducing the product to a powder with a muller. This egg-powder kept good a long time; the only objection was that its price was little less than that of fresh eggs, for though the powder was made when and where eggs are cheap, the cost of making the powder and commissions for selling it absorbed the profits. This might not be the case if the yelk of eggs, the albumen of which is used by photographers, were thus converted into portable and easily preserved food made when eggs are very plentiful, and sold when and where they are in great demand. Egg-yelk dried so as to powder, remains as good for months as fresh eggs for puddings and cakes, and if the yelks of all the eggs, the white of which is now used for albumen, were thus dried, an important addition to our food supplies would be obtained, especially useful for children and invalids. The cost for carriage of dry yelks would be far less than of entire eggs, while loss from breakage, and of eggs going bad, would be almost entirely saved.

If the demand for eggs used for puddings, &c., were thus supplied, that for fresh eggs might be so much diminished as to bring them within the reach of many to whom they are now a costly luxury.

Sugar "Improved."—A case of adulteration of sugar recently occurred at Marseilles. Fraud had long been suspected by the Customs officials, and a cargo of sugar from Réunion was at last made the subject of special examination. The Réunion sugars, of brown hue, are very rich in saccharine matter, and well suited for mixture. It was at first thought that the sugar had been mixed with pounded bricks and sand; but on analysis the added matter was found to be slag (a sort of opaque glass formed in the working of various metals, or vitreous lava from volcanoes) along with sand; and a saving of 12fr. per 100 kilogs. was anticipated. The slag has a bright granular fracture, so that it made a very good imitation of sugar; the sand was added to make up the weight.

More than Enough.—George Elliott, aged seventeen, whilst at Sheffield fair in the beginning of June, ate so much food that he died from gluttony; a potato pie, a plum pudding, some gingerbread, a rice pudding, five squares of Yorkshire pudding, three basins of soup, beer, lemonade, and water constituting his dinner. At the inquest it was stated that death was caused by inflammation of the stomach.

Portuguese Oysters.—Attention was lately called in the French Academy to the properties of the oysters called Portuguese, brought from the mouth of the Tagus. They are richer in bromine and iodine than those met with on the English coasts, and are a valuable article of food, well deserving the attention of hygienists. One kilogramme of Portuguese oysters extracted from the shell gives 700 grammes of water—a slightly violet colouring matter from the liver, 0·039 of iodine and 0·052 of bromine. The oysters cannot be cultivated further north than the warm waters of Portugal or the south of France. Near Lisbon they occupy a large bank of about 50 kilometres. They are distinguished in appearance partly by their claw-shaped shell.

Edible Birds' Nests.—A report sent to the Colonial office from Labuan gives a curious account of the edible birds' nests which are included among the articles imported for the export trade to Singapore. These nests, we are told, are found on the walls of caverns in limestone and sandstone hills all along the coast, but by far the greater part of the supplies received at Labuan are brought from Sandakan Bay, and the Kina Batangan River, on the east coast of Borneo. The devourers of these dainties, it seems, distinguish three qualities of them, known as white, red, and black. They are produced by two kinds of small swallow. The black nests are by far the most common, and are of much inferior value, one especial drawback being that they are "much mixed with dirt and feathers." Of the finest quality are the white nests, which are without admixture of refuse matter, and of a semi-transparent white substance, resembling isinglass or gelatine. The red nests are of intermediate appearance between the white and black, and are supposed to be made by the bird which constructs the white nests, but at a different season of the year. There is a marked distinction in the price of these delicacies; the white nests sell for 45*s*. the "catty," the red for 20*s*., the black for 4*s*. 2*d*.

Machine Fattening of Poultry.—The *Times'* Paris Correspondent, describing a visit to the cattle, sheep, pig, and poultry show at the Palais de l'Industrie, which is known by the comprehensive name of "*Le*

Concours Agricole," says:—"The most curious sight in the building is a machine for fattening poultry. A large circular drum, divided into compartments, each containing a fowl or duck, slowly revolves past a man on a pedestal, who, as each bird passes, catches it by the neck, forces a pipe into its mouth, and gives a stamp with his foot, thereby shooting a paste composed of barley and Indian corn into the victim's stomach. The inventor asserts that his system is 'very salubrious,' but I should doubt whether a hen or duck would not prefer to forage, or at least eat, for itself. Indeed, I saw several of the prisoners evidently trying to commit suicide by pecking at the green paint on their prison walls. The agony of the poor birds when their mouths were forced open, and their looks of astonishment on being released from their involuntary meals, excited a good deal of laughter among the crowd; but, as a farmer near me observed, it is to be hoped the invention will not be extended to a higher class of bipeds."

The Worth of Apples.—The value of apples as food, especially when the apples are roasted, is hardly yet recognised among us as it ought to be, but their value in feeding cattle is comparatively unknown, except in America, where it has been discovered almost by accident. Here we occasionally give a horse an apple by way of a treat, and it is well known that the animal considers it a luxury; but, except that we get rid of windfalls by giving them to the pigs, we make no use of apples as cattle food. In America, however, apples are more plentiful than with us, and sometimes they have so many that they do not know what to do with them. Hitherto there has been an idea that they did harm if given to horses or cows, but a Mr. Storer has come to their defence, and has demonstrated that, if given in combination with some highly nitrogenous food, they are not only harmless but profitable, though he will not go so far as to accept the popular rule that they are about equal in value to their own weight of potatoes. The chief thing noticed in the chemical constitution of the apple is its lack of albuminoids as compared with carbohydrates. The proportions are albuminoids, 1·43; carbo-hydrates, including fat, 91·59; cellulose, 5·54; ash, free from carbon and carbonic oxide, 1·46; and the proportion of dry matter in the fresh material, 16·84. Neither apples nor pulp from cider mills ought, thinks Mr. Storer, to be wasted or merely used as manure.

A New Article of Diet.—A report has been made by the Acting Political Superintendent, Akalkoit, to the Government of Bombay, stating that there exists in those parts a weed called "mulmunda," the seed of which is used for food by the poorer classes in times of scarcity. The seed is ground into flour, of which bread is made. The bread is said to be sweet in taste, and, although not quite so satisfying as could be desired, does very well to keep body and soul together at a pinch. It is also given to camels for forage. The result of an examination of the plant, which is of a leguminous description, by the Acting Chemical Analyser to the Government, shows that the seeds contain nearly as much nitrogenous matters as some of the chief varieties of Indian peas and beans; and hence the nutritive value of the seed should be taken as equivalent to any of the other leguminous grains. The weed is said to grow all over the Deccan and Southern Mahratta country.

The Effect of Cold on Milk.—The effects of a low temperature on milk have been carefully examined by M. Eug. Tisserand, who recently communicated his observa-

tions to the Académie des Sciences. He found that, if cows' milk is immediately, or soon after being drawn, placed in vessels at various temperatures between freezing-point and 60° F., and the initial temperature is maintained for twenty-four or thirty-six hours, it will be found that the nearer the temperature of the milk is to freezing point the more rapid is the collection of cream, the more considerable is the quantity of cream, the greater the amount of butter, and the better the skimmed milk, butter, and cheese. These facts, he believes, may be explained by Pasteur's observations on ferments and their effect on the media in which they live. It is probable that the refrigeration arrests the evolution of the living organisms which set up fermentation, and hinders the changes which are due to their growth. The facts stated indicate room for great improvement in the methods of storage and preservation of milk. To keep milk at its original quality extreme cleanliness and a low temperature are absolutely necessary. In the North of Europe, Denmark, &c., the value of cold is already recognised, and in warmer climates the need for its assistance is greater. There is nothing impracticable in the suggestion, since running streams can be used to aid refrigeration. Where the quality of the milk is of great importance, ice may be employed.—*Lancet.*

Beer-Drinking at Home and Abroad. — According to a work published by Herr Noback, the well-known Austrian engineer, the annual consumption of beer per head of the population is:—In Bavaria 219 litres, in Belgium 182, in England 118, in Prussia 40, in Holland 37, in Austria, 34½, in France 19, and in Russia 14.

London Ale and Porter.—Some interesting results have been obtained from 119 separate analyses of samples of ale and porter sold over the counter by publicans in various parts of London. They show such a percentage of alcohol that it is obvious that a person who drinks two quarts of fourpenny ale or porter, consumes more alcohol than is contained in half a pint of brandy or whiskey. This will, no doubt, astonish a good many people who are apt to think a couple of quarts of ale a day quite a moderate allowance, and when they find intoxication from beer among the lower classes so common, are apt to attribute it to some mysterious adulteration of beer and ale. We have excellent reason for stating that the main adulteration of ale and porter practised in London is the addition of sugar or treacle and water, and the lamentable frequency of intoxication is mainly due to excess of quantity, rather than to defect of quality in beer.—*Sanitary Record.*

What to Eat in Warm Weather.—Under the influence of tropical weather, people anxiously speculate as to the suitability of their diet for the unusual heat, and whether it should not be assimilated to that consumed by our countrymen in parts of the world where the ordinary temperature exceeds 90° in the shade. An adoption of some of the customs in vogue in hot climates is, however, to be carefully eschewed. What can be more conducive to heat apoplexy than "brandy pawnee," and highly curried and seasoned meats, so dear to the Anglo-Indian? Nature points out in exceptionally hot seasons, that the lightest possible food should be taken, and that in moderation. Very little tea or coffee, plenty of milk, with fish, and but little meat, and that well cooked, and a moderate indulgence in iced drinks are indicated. Spirits and heavy wines are, of course, interdicted. It should be known that frequent and excessive thirst is often aggravated by an injudicious

consumption of ice. Such extreme thirst will often be immediately allayed by hot drinks, a fact which has been often verified. It cannot be too strongly insisted on that over-feeding and over-drinking (of any fluid whatever) are more pernicious, especially either before or after prolonged or considerable exertion. The principal meal of the day should be taken at sunset.—*Lancet.*

Fish Sausages.—At an Industrial Exhibition lately held at Viborg, in Jutland, a new article of food, fish sausage, was exhibited by M. Möller, of Apenrade, in Schleswig. It consists of minced salted fish, with the addition of pork and spices. It was highly commended for its taste, durability, and cheapness.

A Word about Drinking Water.—Dr. Sedgwick Saunders, the able Medical Officer of the City of London, has succeeded in stopping the use, for drinking purposes, of a well in Victoria Street, which is proved to be polluted, as are pretty nearly all the London wells. We wish the hint could be taken throughout the country. In the rural districts, fully 80 per cent. of the farms and cottages are supplied with foully-polluted water; and if the owners of such houses were compelled to take measures for purifying the drinking-water of their towns, more would be effected by that measure than by any other sanitary reform which can be mentioned. We have before us analyses of drinking-water from a good class of farms in a home county, which were recently made by a private authority. In every case the water was foully polluted, and quite unfit for human use. Such water is a common cause of summer diarrhœa, and is liable at any moment to become the means of propagating typhoid and other specific fevers. There can be no doubt that it is a main cause of excessive mortality.—*British Medical Journal.*

Coffee Statistics.—According to a Prussian statistical paper, the production of coffee has increased within the last fifty years from 1,900,000 cwt. to 8,500,000 cwt. With regard to the consumption of the article in the different countries of Europe, this is said to be for every inhabitant of Belgium, 8·22 lb. per annum; in Holland, 7 lb.; in Switzerland, 6·76 lb.; in Denmark, 4·83 lb.; in the Zollverein, 4·35 lb.; in Sweden, 3·60 lb.; in France, 3·20 lb.; in Austro-Hungary, 1·46 lb.; in Italy, 0·94 lb; in Great Britain, 0·83 lb.; and in Russia, 0·18 lb.

The Preservation of Meat.—A communication on the preservation of meat has been made to the Paris Academy of Sciences, to the following effect, by M. A. Reynoso. The means employed are compressed air, oxygen, nitrogen, hydrogen, &c. M. Reynoso says he has succeeded in preserving meat, fresh and with the blood in it, in the case of beef, in pieces weighing 63 kilogrammes, for periods ranging from one month to three and a-half. So long as it remained in the apparatus it remained fresh and full of blood, and when taken out it kept a longer time than fresh meat from the butcher. In the case of mutton, he notes the remarkable fact that the meat, after having been subjected to the action of compressed gases, and being taken out of the apparatus and exposed to the air, dried slowly, and then kept good for an indefinite period. The inventor says that meat preserved by the method in question is equally fit for making soup or for roasting, and that the blood has flowed from a piece of beef which had been preserved for forty days. When carbonic oxide is employed the meat undergoes a change, and the colour changes to bright rose, but the other gases produce no such alteration. M. Reynoso says that his exper

ments have been pursued for two years on a very large scale with constant repetitions. Another communication has been made to the same academy by M. de Herzen, the inventor, who has applied his process at Buenos Ayres. It consists of steeping the quarters of meat in a pickle composed of 8 parts of biborate of soda, 2 of boracic acid, 3 of saltpetre, and 1 of salt, in 100. The meat is packed in barrels, which are filled up with a little of the pickle, and is ready for use after soaking in water twenty-four hours. —*Journal of the Society of Arts.*

Eating in India.—Surgeon-Major Johnston, in a paper read before the British Association, "On the Diet of the Natives of India," came to the conclusion that the natives require much more nitrogen and carbon than Europeans, and also took much more salt, owing to the comparative absence of salt from the substances which form a large part of their food. The natives took more dry food than the Europeans, and those who lived on food from the tables of the Europeans enjoyed a considerably greater immunity from cholera than others.

Alcohol as a Food Preserver.—A Swiss Professor of Chemistry has patented a new process for the preservation of meat, fish, vegetables, butter and cream, the novelty of which consists in the addition of alcohol to the usual solution of salt. The only probable objection to the method is the hardening of the fibre of the meat. One advantage would be the combining of meat and drink, as is done by the London water companies, and the mixture might suit weak-backed teetotallers. For preserving butter, the professor mixes 2 lb. of alcohol of 90° strength with every 100 lb. of dairy produce. Thus the compound would resemble a savoury candle very popular in Sir Wilfrid Lawson's county, and tend, where used, to enliven the gay and festive assemblies of the Brick Lane Branch and kindred institutions throughout the country.—*Iron.*

Is the Butter Pure?—The chemical officers attached to the laboratory at Somerset House have recently issued a report on their analysis of butter. They find that the easiest way of determining the purity of butter is to ascertain its specific gravity when melted at the temperature of 100° Fahr. The specific gravity of butter, they find, seldom falls below 910, whereas the specific gravity of animal fat varies from 902 to 904. Butter, therefore, is more dense than fat. But it is only when melted that its density can be properly ascertained.—*Illustrated London News.*

Nutritive Food.—The problem of feeding the young and the poor physiologically, is not easy, but it is simple if considered from the scientific point of view. That the bulk of the food of the poorer classes must always be bread is unquestionable. Peas, beans, and other like leguminous plants, however rich in albumen, can never be expected to successfully compete with bread; first, because they require steeping in water and boiling for hours—next, they become hard so easily, and then are indigestible, while at all times they are not so easy to be digested as bread. But bread is not so good a food as meat, and here chemistry comes in, and shows that bread soaked in broth made from extract of meat is as good food as the best meat diet. Indeed, the most eminent chemists and physiologists are now agreed in the opinion that, when people will use more of such simple vitalising extract, and a little less tea, for their strength and health, they will be willing to dispense with the present artifices of cookery as numberless as they are useless.

To Preserve Eggs.—For pre-

serving eggs M. Lace recommends to coat them with paraffin, 1 kilog. of which will be enough for 3000 eggs. The eggs should be fresh and new-laid; decomposition, once begun, will go on in spite of the coating of paraffin.

The Use of Water.—The *Sanitary Record* remarks on the distaste shown by the working classes to water as a beverage, and states that at an adult school, when the pupils were asked what water was for, the answer was, "to give to horses," another, "to slake lime with." The application of water to quench the thirst of human beings did not seem to be known to the rising youth educated at the school in question. The *Sanitary Record*, however, attributes this distaste to water to the bad quality of the fluid supplied under that name to the poorer classes, and the additional impurities it absorbs from the very deficient method of storage in water-butts and defective cisterns.

The Setting of Milk.—Mr. L. S. Harding, of Louisville, Kentucky, has recently made a series of experiments regarding the setting of milk. He states that deep setting accompanied with refrigeration is the best plan. The milk is placed in cans from 12 to 20 inches deep and 8 inches in diameter. These are put in a refrigerator box, with a shelf in the top, upon which ice is placed, and the temperature is reduced below 50°. The milk is skimmed after thirty-six hours. The cream is churned at 58° in warm, and at 63° in cold weather. The butter is said to be of superior flavour and aroma, uniform in quality, and to keep well; and a greater weight is obtained from a given quantity of milk with less labour and less cost than by other methods.

Very like "Native" Oysters!—Some revelations, which are calculated to surprise the oyster-eating community, were made in a case which came before Mr. Recorder West at the Manchester Quarter Sessions, involving a charge of theft against one Charles Smith. The prisoner was employed as oysterman at "The Manchester (Limited)," a restaurant below the Royal Exchange. On the 18th of January he got 4*l.* from the cashier to buy oysters, but absconded with the money. On his apprehension a month later at Harrogate, he denied the theft, and said he had left the place because he was disgusted at having to supply Dutch oysters as natives. The cashier and the manager of the restaurant admitted, under cross-examination by the prisoner's counsel, Mr. Cottingham, that it was the practice to put Dutch oysters into native shells, and sell them under the pretence that they were native oysters. The profit on Dutch oysters was large, while that on natives was small, and oysters of the former class, placed on native shells, in the lower part of the premises, made the customers think they were getting large natives. This trick, the manager stated, was not known to the directors. He was the responsible person, and "kept it quiet." It was done at the suggestion of the prisoner. The prisoner was found *Guilty*, and was sent to gaol for six months. In passing sentence, the Recorder expressed a hope that such discreditable tricks as the one which had been revealed were not universal, and said that a tradesman had no more right to pass off Dutch oysters as natives than to sell any other inferior article as superior.

Cooking by Cold.—It is a curious fact, not generally known, that the action of intense cold on organic substances is similar to that of a high degree of heat, and that, when subjected to a very low temperature, meat can be brought to a condition similar to its state when cooked by actual warmth. Quite recently a Hungarian chemist, Dr. von Sawic-

zewsky, who, it appears, has investigated all the various ways suggested for preserving meat (by chemicals, cooking by heat and hermetically sealing, &c.), and has found points of objection to all, has attempted the preparation of the material by subjecting it in a perfectly fresh state to a temperature of 33° below zero, Fahr., and sealing it afterwards in tins. The results obtained have been highly satisfactory; the meat on being removed from the cans appears, in point of smell and colour, as fresh as if just taken from the butcher's stall. Although partially cooked, and thus requiring less fuel to complete its preparation for the table, it is entirely without the taste of meat which has been partially subjected to any heating process, and may be roasted, boiled, or otherwise treated, the same as if it were fresh. A commission appointed by the German governments has lately conducted a series of careful and successful experiments upon the process; and as a final test two corvettes of the German navy, being about to circumnavigate the globe, have been supplied with a large stock. An extensive factory is being erected in Hungary for its manufacture.

Butter Globules in Milk.—It is probable that many amateur microscopists are not aware that butter globules can be seen in milk immediately on its leaving the cow. A drop of milk examined with a pretty high power shows many thousands of the globules floating about in the fluid. These are rather lighter than the fluid itself, and they gradually rise to the top, forming cream. After being dashed against each other for a time (or churned, as the term is), they adhere together, and we have butter.

Sham Coffee.—We learn from a statement in the *Journal of the Chemical Society* that sham coffee is manufactured from tough dough, squeezed into little moulds, and baked until the colour becomes dark enough to deceive the eye. Real coffee-berries, when small and worthless, are improved in colour by rolling them about with leaden bullets in a cask. The green berries, too, are treated by a colouring matter. In coffee sold ready ground the difficulty of detecting adulterations is greatly increased; beans, beet-root, carrots, and carrot-like roots are roasted and mixed in large quantities with the genuine article. In the South of Europe, especially in the provinces of Austria, figs are roasted in enormous quantities and sold as coffee.

For Water-drinkers.—It has been determined that the addition of from 0·0005 to 0·001 part of salicylic acid to cistern-water clarifies the same in a remarkable manner, and that which ordinarily, in the space of a month, would become foul and unfit to drink remains perfectly pure and limpid. This property of the acid will doubtless be found of great value on board vessels making long voyages, as it has been determined that scurvy is often produced by the deterioration of water through too long sojourn in casks and tanks. The combination of salicylic acid with calcareous salts has also been noted by M. Berger to be so intimate that water thus charged and treated may be evaporated even to dryness without any lime deposit being formed. The acid is therefore one of the best preventives of steam-boiler scale and incrustation.—*Scientific American.*

Cheap Butter.—The *Medical Examiner* has it on competent authority that if the Adulteration Act were carried out in its integrity, and none but genuine butter came into the market, it would disappear from the table of the middle classes, its price, quite 5*s.* a pound, precluding its use by all except the rich. Such being the case, the supply falling short of the demand, how is this met by the pro-

ducer? By adulterating all butter! Fortunately none of the substances used for adulteration are in any way injurious. Those chiefly employed are water, salt, starch, flour, dripping, lard, marrow-fat, beef-fat, and horse-fat. The great art in the manufacture of cheap butter is to get it to hold in suspension the largest possible quantity of water. A certain quantity of water is always present and improves the butter; the same may be said of salt, both for flavouring and preserving it. But the manufacturer uses both in excess; both are cheap diluents, and the latter enables the butter to hold a much larger quantity of the former than it would otherwise. A great deal, however, can be done in the manufacture to make the texture of the butter such that it binds the water, and this process has to be varied according to the season and temperature.

A New Adulteration of Port Wine.—This new adulterant, unlike many others, is easily detected by non-chemists, and is in some cases dangerous, especially when partaken of by the feeble, delicate, and convalescent. It is an artificial colouring, which, Shuttleworth says, consists of a mixture of azalin and magenta red. The analine colours, objectionable in themselves, are the more dangerous because they not unfrequently contain arsenic. The adulteration is detected by shaking the suspected wine (and all cheap wines are to be suspected) with an equal volume of amylic alcohol (fusil oil). If the wine is genuine port, the amylic alcohol remains colourless; but if adulterated, it dissolves out the colouring matter, and itself appears of a purple red colour.

Colouring Matter for Food and Drink.—For colouring articles of food and confectionary, the Parisian police authorities have recently prescribed the exclusive use of the following:—Blue, indigo and its derivative, Prussian blue; red, cochineal, carmine lake, Brazil wood lake, archil; yellow, saffron, berries of Avignon, Persian yellow berries, yellow wood, quercitron, turmeric; green, mixture of logwood and Prussian blue; violet, mixture of Prussian blue and carmine. Forbidden are cupric oxide, blue carbonate of copper, oxide of lead, cinnabar, chrome yellow, gamboge, Scheele and Schweinfurt green, and white lead. For colouring of drinks are recommended—for Curaçoa, logwood; for absinthe, soluble indigo blue with saffron; for blue liquids, soluble indigo blue, Prussian blue, and ultramarine.

Milk and Tainted Meat.—Attention was drawn during the summer to a practice prevalent in some parts of the country, which appears to illustrate the power possessed by milk of absorbing atmospheric impurities. It is that of placing a saucer of new milk in a larder, to preserve meat or game from taint. It is said that not only does it answer that purpose, but that the milk after a few hours becomes so bad that no animal will touch it.

Spirits from Russia.—A noticeable feature in the spirit-market just now is the introduction of a neutral spirit from Russia, which we learn is being sold extensively at 1*s.* 1*d.* per gallon—about 1*s.* per gallon less than British grain spirit, and cheaper even than the German spirit distilled from potatoes, which has hitherto been so largely sold. This new spirit, when flavoured and sweetened, will doubtless enter into consumption through the public-houses, under the name either of gin, rum, whiskey, or brandy.—*Wine Trade Review.*

Hampers of Game.—"Sportsmen," says Mr. D. G. F. Macdonald, writing to the *Times* in the autumn, "will soon be sending game to their friends, and as grouse are a great

temptation to railway and other *employés*, I would suggest that they be forwarded in hampers, the lid stitched round with good strong twine, and the two ends knotted and sealed. I never had a hamper robbed that was treated in this way. Game has been constantly stolen from deal boxes, which are easily wrenched open and reclosed without showing any sign of having been tampered with.

"Moreover, game keeps better in baskets, as the air passes freely through wicker-work. I have found, too, when birds are hard shot that sprinkling pepper and salt under their wings and packing in heather and wild myrtle keeps them sweeter than anything else."

The Art of Plastering Wine.—The plastering of wine consists of treading in with the grapes a kind of plaster known in Spain as "yeso," about 10 lb. being added to the quantity of grapes required to make a butt of wine (108 gallons). The "yeso" reduces the acidity, and "is used equally for red and white wines, but is not employed in the preparation of the sweet wine, 'vino dulce,' made from over-ripe grapes for the purpose of tempering sherry." Besides plaster, other substances are added to wine, and affect the composition of the lees. A substance known as Spanish earth is commonly employed in Spain for fining the wines. This earth is also occasionally used by English wine merchants for a similar purpose. This so-called Spanish earth has a somewhat soapy feel, easily impressed by the finger-nail, but containing sometimes fragments of slates. "When rubbed in the hands under water the earth is resolved into an unctuous paste, and it is in this condition applied to the wine which it is destined to clarify."—*Journal of the Chemical Society.*

Fresh Meat from America.—The new method of importing fresh-killed meat from America appears to be fairly successful. It is known as the cold dry-air process, and the weight of meat thus sent in six weeks in the beginning of the year amounted to about 300 tons. The cattle intended for shipment by this method are killed a day or two before the vessel starts, great care being taken to extract all the blood. The quarters are then sewn in canvas, and swung in a compartment of the hold, in which the temperature is kept down to 37 deg. by means of tanks of ice, a constant motion and circulation of the air being maintained by means of a large fan worked by steam. Meat thus kept in a dry, cool atmosphere for ten or twelve days, has a more marketable appearance at the end of that time than it had when killed; and, as a matter of fact, the consignments reached the market in splendid condition—cool, dry, firm, and free from the slightest taint.

Preparations are said to be making to send larger and more frequent lots. The preserved meats, owing to the necessity for over-cooking them, and on other accounts, have never become really popular with the masses; and the introduction from abroad of dead meat in good condition, will influence the market favourably for consumers. The process ought also to enable meat for the metropolis to be killed at the place where it is reared, and brought up by rail which will also tend to cheapness.—*Iron.*

Condensed Beer.—A patent for condensed beer has been taken out by Mr. Lockwood. The liquid may be taken at any stage of fermentation, although it is thought best to treat it when fit for drinking. It is evaporated in a vacuum, until a large part of the water and alcohol is distilled away, and the beer is reduced to a thick, viscid fluid of about the consistency of molasses. The alcohol and water pass off in

vapour, which is condensed, and the alcohol subsequently obtained by re-distillation is mixed with the condensed beer, either before bottling or at any time afterwards. In this way beer may be reduced to one-eighth or one-twelfth its original bulk, and it is said to keep for any length of time. To restore the beer to its first consistency, it is only necessary to add the bulk of water distilled off, with a small quantity of yeast or other ferment, and in forty-eight hours the beer will be ready for bottling. If charged with carbonic acid in a siphon bottle or receiver, the necessity of renewing the fermentation is obviated.

Beans, Wheat, and Rice.—Dr. Bellows says that one pound of beans will support life in action as long as four pounds of rice. Two pounds of beans will help to do more muscular work than three pounds of wheat, and more brain-work than three and a half pounds. The reason why beans require stronger powers of digestion than wheat is that they contain caseine instead of gluten.

American Water Tipplers.—Strange as it might seem to the conscientious man who comprehends the deleterious effects of cold drinks, there are thousands of our best and noblest citizens who are victims to the cold water habit. They begin the day with one or more glasses of ice-water before breakfast. During that meal they frequently turn from the coffee which cheers but does not inebriate—in case it is sufficiently adulterated with the simple and healthful bean—and satisfy their depraved thirst for water. On their way to their business they stop at the numerous drug stores which shamelessly flaunt their soda-water fountains in the face of the public, and hastily pour down the deadly ice-water which perverted ingenuity makes palatable with cream and syrups. In the office or the store, the water-cooler, filled with the stomach and tooth-destroying beverage, is always at hand, and when the water-drinkers return home after a day of constant drinking, they too often spend the greater part of the night in solitary and aquarial debauchery.

The result of this pernicious practice has been to fill the country with a class of stomachs that are incapable of any earnest digestive efforts, and to crowd the chairs of busy dentists. American stomachs and American teeth are daily growing feebler, and the time is apparently at hand when a set of false teeth will be presented to every new-born infant at the same time that he receives his first indiarubber ring, and when all sorts of stomach bitters and digestive pills will invariably supplement his daily meals. For this state of things, ice-water, either in its undisguised form or in the shape of soda-water, is responsible. And the worst of it is that the victims of the water-habit are the very men who form our temperance societies, and who fancy themselves temperate because they never drink anything but water.—*New York Times*.

Our Oyster Supplies.—During these last four or five years, the public have experienced what may be termed an oyster famine. Oysters of all descriptions have been gradually growing in price, till, despite the quantities brought from foreign countries, they have become a luxury which only wealthy people can afford. A dressed codfish, with oyster sauce, now proves too costly for persons of moderate income. A guinea for the fish, and half as much for oysters, compels the frugal housewife of the period to pause before she enters such an item on her bill of fare. The cost of "natives" has been lately 14*l*. per bushel, which is undoubtedly a high figure for an article that thirty years ago was

sold in many places at almost a nominal price, or for the sake of inducing the purchase of liquor was given away to all and sundry! As a bushel of oysters contains about 1600 individual molluscs, the cost of each, when purchased at wholesale rate, is a little over 2*d.*; but after the dealers have taken their profit, the public will require to pay at least 3*d.* for each native. The Oyster Corporation of Whitstable, strange to say, is not waxing wealthy over the price just quoted: indeed, the high cost of the article has brought business almost to a stand, and the Whitstable men now deal in the commoner kinds of oysters in order to obtain a profitable trade. The reason for the scarcity, however, and the consequent high price of oysters, is not far to seek. It may be illustrated by the old saying that "we cannot both eat our cake and have our cake." We have so overeaten our oysters, have so broken in upon the capital, that the supply has decreased, chiefly from the lack of breeding stock.

So much has been written of late about the oyster, and so many theories have been recently propounded for making it again plentiful, that the public had begun to hope for the return of old times, and once more expected their favourite repast at the former price of 1*s.* per dozen! Oyster culture *à la Français* was the medium which was to enrich our oyster beds. The French, we were told, had discovered a method of indefinitely increasing their oyster supplies. "We have only to do as the French do, and we may at one fell swoop double or treble our produce." Such, three or four years ago, was the *mot d'ordre.* For a time this kind of pisciculture became the rage, and we were told that, if we only waited a little longer, the English coasts would become as rich in oysters as the coasts of La Belle France. Well, we have waited, and what is the result? This, namely, that we are now paying a higher price for our natives than before the rage for oyster-culture came upon us. It seems to have been forgotten that we already cultivated our oysters in England. The Bay of Whitstable has long been given up to oyster cultivation. There we find one of the most prominent organizations for the supply of oysters that there is in England. It has existed for a long period, and has been throughout signally prosperous. It is not at all difficult to describe what is done at Whitstable. They do not at that place breed the natives in which they deal; they receive the oyster brood of other places, and grow it on their rich feeding grounds till it is ready for market. On the opposite shore of Essex "they can grow oysters, but they cannot feed them." At Whitstable, as we were recently informed by one of the freemen of the company, they can "feed them, but cannot breed them." The work, therefore, which is carried on at Whitstable is the feeding of oysters for the London and other markets. The Corporation of Whitstable will buy any quantity of brood from anybody who has it for sale. "Brood," or "ware," it may be stated, is represented by oysterlings of about the size of a threepenny piece. The authorities at Whitstable will give a fair price for ware, and when they get it they will lay it down on their feeding grounds, "they will nourish it and cherish it," for four years, and then, as the old song says, they will send to market "the finest native oysters that ever you did buy?"

It may interest the general public to know the changes undergone by spat before it is brought to market in the shape of well-flavoured natives. Our readers may have been informed that the oyster yields its young in literal millions. They must

not believe that; but that the animal is a prolific one as regards production we think is certain. We shall not at present pause to inquire whether or not each pair of shells encloses a male and female. Some naturalists say that it is so; but the first great fact that comes home to us is that the infantile mollusc requires a holding-on place. If the tiny creature cannot anchor itself to some coign of vantage, it is lost for ever—swept away by the ravening waves of the sea. It has been calculated, with probably some exactitude, that the oyster grows as follows, and it is on this basis that the Whitstable Company exists and flourishes:—At the first blush of life it requires 25,000 oysters to fill a bushel measure. In the second year, however, the animal has so grown that 6400 individuals will occupy a similar space. In the third year the molluscs have still further increased in bulk, and only 2400 are then required to fill each bushel; and in the fourth year, when the oyster may be held to have thoroughly ripened and to be ready for market, the measure in question will only hold 1600 oysters. Supposing, then, that the Whitstable Company purchase a bushel of oysters in the first year of their growth at about 14*l.*, what will be the amount of profit the Corporation will derive from the venture four years afterwards? It must, we think, prove rather considerable. The reader can take the 1600's in 25,000 and calculate the result. There occurs, of course, considerable mortality, but it will not be more in a careful nursery than a twentieth part of the whole.

It has been wisely decreed that there must be a close time for oysters, and the habits of the animal being pretty well known to naturalists, it was not difficult to hit upon the months during which the scalps should be allowed to rest. If we could hit with similar precision on a close time for our sea fish, the supplies might, in time, be considerably augmented; but it is remarkable that it is only when some kinds of fish are about to spawn that we can obtain them. The herring may be instanced as one of the fishes that we only procure when it is least fitted for the food of mankind. Unfortunately, the close time for oysters is not so well observed as it ought to be, seeing that we can obtain them all the year round in London and other populous cities. It is that fact which helps to decrease the supplies, and were it not that there is a large number of proprietary beds held by companies and individuals, the animal would probably before this have become extinct. There is still a wonderfully large amount of commerce in oysters, and if we were to be specially favoured with a prolific spawning season, the future supply would become more assured than it is at present. It must not, however, be forgotten that an oyster requires a period of four years to arrive at maturity, and that, if a fall of spat occurred next summer, the oysters derivable from such fall would not be marketable till the year 1880. That even the most populous natural oyster scalps are vulnerable and easily affected is well known to experts. The Edinburgh beds at Newhaven, which are of great extent, were some years ago so despoiled as to be in danger of rapidly becoming barren. The beds in question belonged to the Corporation, but were worked for the benefit of the fishermen of Newhaven, who paid a nominal rent for the privilege. The Newhaven men were also lessees, at a trifling annual sum, of the oyster beds belonging to the Duke of Buccleuch; but his Grace, on being informed that the men were spoliating the scalps, or, in other words, were selling enormous quantities of small

oysters that had never had an opportunity of spawning, to English and foreign oyster fatteners, re-let the beds to a more cautious tenant, who is working them in a different fashion from the Newhaven fishermen. The scalps belonging to the City of Edinburgh could not very well be taken from the Newhaven men, but on a new lease being granted, they were bound not to sell the small oysters; and now, we believe, there is a chance, although oysters are still very scarce at Edinburgh, that the beds will ultimately recover their former prosperity. The Firth of Forth is, in a sense, one vast oyster-bed, the scalps, more or less thickly populated, extending from Queensferry to Prestonpans, the home of "the whiskered pandour," a distance of about twenty miles. It was calculated a few years ago that the scalps which the Newhaven men had the right of dredging yielded about 10,000*l.* per annum. But that fine revenue soon dwindled away when the men began to send the seed oysters in hogsheads, day after day, to Hamburg, Ostend, and Whitstable. Thirty years ago, 100 of the fine Firth of Forth oysters could be bought in the Edinburgh market for less than 1*s.* It is fortunate that the system of private layings has considerably extended, although we believe the right of laying down oyster beds is not so largely taken advantage of as it might be. Recent legislation has also aided in the preservation of our oyster fisheries, but there is still a great deal to be done in the way of extending the supplies and of working and cleaning the beds, so as to destroy as many of the numerous enemies which prey on the oyster as possible. As showing the magnitude of the demand for oysters, it may be mentioned that from the natural beds of the Wash as many as 700,000 sizeable oysters have been lifted in three months.

Many of the French natural oyster scalps which are now almost, if not quite barren, were at one time exceedingly productive; but in time, as opportunities of quick transport extended, they also were over-dredged, till in some cases an insufficient breeding stock was left, which, coupled with an occasional intermission in the fall of spat, speedily rendered the oyster a scarce commodity in France. Artificial breeding has in some degree restored the oyster to the French, but it is questionable if the mollusc is produced in such large numbers as is represented. A portion of the English oyster supply is now, however, derived from France, and the import from America is increasing, large quantities being received every week in Liverpool, Glasgow, and elsewhere. We need them all.

Other kinds of shell-fish are becoming as scarce as the oyster. Shrimps and prawns, notwithstanding the ceaseless industry which purveys them for the markets of our great cities, are becoming less plentiful year by year. As for our mussel supply, it is likely to cease altogether in a few years for want of spat to populate the scalps. The unceasing demand on our mussel beds for bait is sure in time to affect the supplies. As many as 4452 tons of mussels have been obtained this season from the fisheries at Lynn. Each ton of mussels, it may be noted, is of the value of about 1*l.* sterling at first cost. This shell-fish, as well as being used for bait in the hand-line cod and haddock fishery, is extensively made use of instead of oysters for sauce, for which purpose it is excellent, when in proper season. With regard to the whelk fishery, it would be well if it were conducted with greater care. The men will find out some day the truth of the old adage about wilful waste bringing woeful want. The greed of our fishermen

is at present so great that they seize upon all the sea produce they can obtain, no matter whether it be ripe for food or not. It is a misfortune of the whelk fishery that the small ones are captured as well as the larger ones, and ruthlessly sent to market. They might as easily be restored to the waters and allowed to grow for a few months longer—above all, be permitted, at least once, to reproduce their kind. What is done in the shrimp fishery at some places might be done with the whelks—they could be passed through a sieve, and only those of a certain size be selected for use. From some inquiries made by one of Her Majesty's Inspectors of Fisheries (Mr. Buckland), we find that the yearly value of the whelk fisheries must be very considerable, those of Lynn and its neighbourhood being set down as being worth 6000*l.* per annum. It would not be too large a sum if we were to set down 250,000*l.* as the produce of what may be called our minor shell-fish fisheries. As to lobsters, it may be stated, without fear of contradiction, that they have become of late more and more difficult to obtain; and, as the public may now judge for themselves, those now brought to market are several sizes smaller than the lobsters of ten or twelve years ago. Why so? will be asked. The answer is simple. All the fine old lobsters have long since been devoured; we have eaten them down to the present size, and in all probability we shall stop eating them down only when they come to the vanishing point. At one period, say twelve years ago, the more Northern Scottish seas abounded with gigantic specimens of these favourite crustaceans, and vast numbers of them were annually sent to Southern markets in perforated boxes, or packed in sea-weed. Now, as we were recently informed, on the west coast of Scotland these giants of their race have been exterminated, and recourse is being had to such as can be captured, no matter what may be their size.

In conclusion, whatever opinions may be held as to whether our supplies of round and flat fish are increasing, remaining stationary, or diminishing, it is certain as regards lobsters and other shell fish that the supplies are falling off, and that the size of many of them is in process of annual diminution. An intelligent Edinburgh fish merchant is of opinion that, if some remedy is not speedily provided, there will not, at the expiration of another five years, be any lobsters worth bringing to market. These animals, being caught in cages or pots, can be handled with facility, so that those of improper size might easily be rejected, as also those in berry. At that time they ought not to be captured. It is the misfortune of sea fisheries of every kind that they are free to all. Each man who fits out a vessel fights for his own hand, feeling that if he were to reject a fish from its being undersized, or in an unfit state for table purposes, his neighbour would at once capture it. Whatever its condition, it will realise a price of some kind—it will fetch money in the market-place—and that is the philosophy which at present governs our fisheries.—*Times.*

XV.—MEDICAL.

A Pleasant Way of Taking Castor Oil.—Mix ten grains of powdered tragacanth with two drachms and a half of water; upon this pour very slowly, drop by drop, half an ounce of castor oil, stirring constantly with the pestle. When the mixture is complete, add about three ounces of water, an ounce of syrup, and a few drops of laurel-water. In this manner a white emulsion is obtained, in which the taste of the castor oil is (according to the *Paris Médicale*) quite masked, and replaced by the perfume of the laurel-water.—*Lancet.*

Poisoned Sleep.—Sleep is a boon commonly regarded as priceless, but it may be purchased too dearly. Macbeth murdered sleep; a very large and, unhappily, increasing number of well-meaning but misguided persons poison it. The medical profession has a keen interest in the growing practice of habitual recourse to sleep-potions, because it is with the connivance of the profession, if not under its specific advice, that these soporific poisons are employed. We think the time has come when some strong means should be taken to clear medicine from the reproach of countenancing the lay use of opium, chloroform, chloral, chlorodyne, and the rest of the sleep producers. The public should be told that they are playing with poisons. If they escape a so-called "accident" which ends in sudden death, they are scarcely to be congratulated, since if the body does not die, the brain is disordered or disorganised, the mind enfeebled, the moral character depraved, or evils hardly less deplorable than death are entailed. The consideration may be agonising, but it is urgent. The sleep produced by these narcotics or so-called sedatives—let them act as they may "on the nervous system directly," or "through the blood," is *poisoned.*—*Lancet.*

Water and Health. — Mr. Baldwin Latham read a paper before the British Association on the importance of Hydro-geological Surveys from a sanitary point of view. The author pointed out that all subterranean stores of water are due to rainfall, and that the water held in store in the earth does not, as a rule, maintain a horizontal level, but the surface possesses a considerable fall in directions corresponding to the points of the discharge of the springs. The inclined surface of the water pointed to its movement in the direction of its outfall or natural vent. The inclined surface was the measure of friction and molecular attraction. Subterranean currents obey the same laws, with reference to their flow, as streams that move on the surface of the earth. A number of examples were given, which showed that falls varied from eight feet to ninety-four feet per mile in the chalk south of Croydon, three feet to 100 feet per mile in the boulder strata of Norfolk, and five feet per mile in the tertiary beds at Garrett.

The importance of pure water was pointed out by the author, who gave several examples which showed the deleterious effects of the drainage from cesspools, sewers, and cemeteries upon water-supply derived from wells, and the effect upon the health of the persons using such water. By means of hydro-geolo-

gical surveys the direction and fall of the subterranean current may be ascertained, and cesspools in country houses so located as to make all the difference between a healthy and an unhealthy home.

In towns there are so many sources of pollution that supplies of water taken from surface wells ought to be entirely forbidden. The condition of health with regard to certain specific diseases in towns like Glasgow, which is supposed to have one of the purest water supplies in the world, may be measured by the amount of well water consumed. Underground currents of water often carry polluted matter under our houses, and we are thus supplied with air from an impure underground atmosphere. The presence of leaky sewers has often led to the introduction of enteric fever by the fouling of the underground water in districts previously exempt from it. In conclusion, the author pointed out that while so much attention was given to the pollution of surface streams, the use of water from which had never been clearly traced as the cause of disease, the pollution of underground sources of water, which had over and over again been shown to be the cause of disease, had almost entirely escaped attention.

The Effect of the Sun on Lunatics.—The *Gazette des Hôpitaux* contains a curious article on this subject. Dr. Ponza, director of the lunatic asylum at Alessandria, Piedmont, having conceived the idea that the solar rays might have some curative power in diseases of the brain, communicated his views to Father Secchi, of Rome, who replied in the following terms:—"The idea of studying the disturbed state of lunatics in connection with magnetic perturbations, and with the coloured, especially violet, light of the sun, is of remarkable importance, and I consider it well worth being cultivated." Such light is easily obtained by filtering the solar rays through a glass of that colour. "Violet," adds Father Secchi, "has something melancholy and depressive about it, which, physiologically, causes low spirits; hence, no doubt, poets have draped melancholy in violet garments. Perhaps violet light may calm the nervous excitement of unfortunate maniacs." He then, in his letter, advises Dr. Ponza to perform his experiments in rooms the walls of which are painted of the same colour as the glass panes of the windows, which should be as numerous as possible, in order to favour the action of solar light, so that it may be admissible at any hour of the day. The patients should pass the night in rooms oriented to the east and south, and painted and glazed as above.

Dr. Ponza, following the instructions of the learned Jesuit, prepared several rooms in the manner described, and kept several patients there under observation. One of them, affected with morbid taciturnity, became gay and affable after three hours' stay in a red chamber; another, a maniac who refused all food, asked for some breakfast after having stayed twenty-four hours in the same red chamber. In a blue one, a highly excited madman with a strait-waistcoat on was kept all day; an hour after he appeared much calmer. The action of blue light is very intense on the optic nerve, and seems to cause a sort of oppression. A patient was made to pass the night in a violet chamber; on the following day he begged Dr. Ponza to send him home, because he felt himself cured. He has been well ever since.

Dr. Ponza's conclusions from his experiments are these:—"The violet rays are, of all others, those that possess the most intense electro-chemical power; the red light

is also very rich in calorific rays; blue light, on the contrary, is quite devoid of them, as well as of chemical and electric ones. Its beneficent influence is hard to explain; as it is the absolute negation of all excitement, it succeeds admirably in calming the furious excitement of maniacs."—*World of Science.*

Artificial Breath.—At a recent meeting of the Paris Academy, M. Woillez described an apparatus which he calls a *spirophore.* It is for the resuscitation of asphyxiated persons, especially those who have been in danger of drowning, and newly-born infants. It consists of a sheet-iron cylinder, closed at one end. The body of the individual is introduced up to the neck, the aperture round which is then closed by a diaphragm. A strong bellows, containing more than twenty litres of air, situated without the case, communicates with this by a wide tube, and is worked by a lever, the descent of which causes the air to be drawn off from the case, while the return motion restores the air. Through a piece of glass in the cylinder, the chest and abdomen of the patient can be seen, and a rod, moving in a vertical tube, rests on the sternum. When a vacuum is made about the body by depressing the lever, the external air penetrates into the chest, the walls of which rise as in life. They return to their former position when the lever is raised, and these respiratory movements may be repeated fifteen to eighteen times a minute, as in a living man. By means of a tube communicating with a reservoir, and inserted in the windpipe, M. Woillez found that a litre of air, on an average, entered the air passages at each artificial inspiration, whereas the physiological average is only a demi-litre. Thus, more than a hundred litres of air can be passed through the lungs of an asphyxiated person in ten minutes. There is no danger of rupturing the lungs, however strongly the lever be wrought, for the force of penetration of the air is never superior to the weight of the atmosphere.—*Nature.*

Impure Ice.—While much is being done to secure the purity of our food and drink, there is little doubt that many possible sources of danger yet remain unsuspected. We do not think many people pay sufficient attention to the quality of the ice they consume in summer. An instructive lesson comes to us from the other side of the Atlantic, in the shape of a report detailing a serious outbreak of an intestinal disorder, caused by the contamination of drinking-water by means of impure ice. The disease occurred among the frequenters of one of the large hotels which are so plentiful in the States, and was characterised by giddiness, nausea, vomiting, diarrhœa, and severe abdominal pain, accompanied by fever, loss of appetite, continued indigestion, and mental depression. An analysis of the water derived from the ice in use was made, and it was found to be horribly foul; while an examination of the pond from which it had been gathered showed it to be chiefly "a homogeneous mass of marsh mud and decomposing sawdust." With the discontinuance of this particular ice the epidemic ceased. The following warning is conveyed at the end of the report:—"The notion that ice purifies itself by the process of freezing is not based upon trustworthy observation. On the contrary, it is utterly wrong in principle to take ice for consumption from any pond the water of which is so fouled as to be unfit for drinking purposes." We have no hesitation, however, in saying that tons of ice are consumed daily in London which have been obtained from ponds the water of which no one would think of drinking.—*Lancet.*

The Medicinal Properties of Eucalyptus Globulus.—The medicinal properties of the *Eucalyptus globulus* formed the subject of a paper read by Dr. Fedeli at the Roman Academy of Medicine. After adverting to the natural history of the plant, and citing a host of witnesses as to its virtues as a febrifuge, Dr. Fedeli proceeded to describe the curative powers of the various preparations of the *Eucalyptus*, especially of the alcoholic tincture, not only in cases of periodic fever and of palustral cachexia in general, but also in aliments of an atonic or anæmic nature. In the discussion that followed the reading of the paper, Dr. Colapiete ascribed the virtue of *Eucalyptus* in malaria to its cultivation increasing the quantity of ozone in the air; while Drs. Marchi and Terrizi opposed this view, the latter maintaining, as the result of experiments made on bacteria and micrococci, that ozone, instead of diminishing, actually increases the fermentative action of the malarial poison.

Caustic Ammonia in Rheumatism.—Judging from his article in a recent German periodical, the *Clinic* thinks that Dr. Franz Zeller is an enthusiast in the administration of caustic ammonia in rheumatism. For several years he had been a sufferer from severe muscular rheumatism in the right shoulder; he had taken all the anti-rheumatic remedies, with but little alleviation, when he began to reason that in rheumatism as in gout there may be a uric acid diathesis. He thought that liquor ammonia, on account of its rapid volatilisation, would be the remedy most readily absorbed and the most prompt in action. In almost the same moment in which he took one drop, diluted with water, he felt a complete relief from the pain, which had lasted for ten hours, and he was now able to move freely the arm which an instant before he could scarcely bear to have touched. The remedy, he claims, has proved a positive cure in all recent cases of muscular rheumatism which have fallen under his observation. He cites numerous cases in which relief as instantaneous as his own was experienced. He also observed its effects in several cases of acute articular rheumatism, in two of which six drops sufficed to subdue the pain and swelling within a period of twenty-four hours. In one case of chronic rheumatism of a finger-joint, which had lasted for over half a year, the simple administration of the ammonia completely dispelled the inflammation and pain in the joint within two days. Dr. Zeller believes the effect due to the ammonia acting as a nervine directly upon the nerves.

An Antidote to Poisonous Mushrooms.—The *Sanitary Record* says: Professor Schiff, of Florence, has demonstrated that the non-edible mushrooms have a common poison, muscarina, and that its effects are counteracted either by atropine or daturine. Italian apothecaries now keep these alkaloids in the rural districts where the consumption of the non-edible fungi is apt to occur. The hint is worth taking in England, where deaths from eating unwholesome fungi are by no means unfrequent.

The Energy Consumed by the Body.—According to Helmholtz, about five times as much energy is used in the internal work of the body as is expended in ordinary productive work. In the case of severe work, the portion of internal work to productive work is still greater. Supposing the work performed by a man to consist of walking, the most economical rate, both as regards the amount of food required to sustain it, and the amount of potential energy expended on the body itself, is about three miles an hour. Both above and

below that speed there is a decrease in the amount of active work as compared with the non-productive energy. A man walking fifteen or sixteen miles a day, or doing an equivalent amount of work in any other form, would require 23 oz. of food, composed of albuminates 4·6oz., fat 3 oz., starch 14·3 oz., and salts 1·1 oz. This would yield a potential energy of 4,430 foot-tons, and 300 foot-tons for productive work. A mere subsistence diet for a man at rest would be 15oz., but with this amount a man would lose weight. About 7,000 foot-tons a day of potential energy is about the greatest amount which is possible as a permanency. This would yield 600 foot-tons of productive work. These calculations apply only to men in health.

Blood-letting at intervals.—An extraordinary case of habitual venesection is reported by Dr. E. Warren Sawyer in the *Chicago Medical Journal* for September, 1875. The subject of the narrative is a retired clergyman, aged 80. His firm step and keen intellect show an unusual degree of preservation for his advanced years. He is a farmer's son, and during his entire life has been unusually free from sickness. When 17 years old, according to the custom of the period, and not for ill-health, he was bled for the first time. This habit of spring bleeding was followed for the next six years. He then became a student, and the change from active farm work to a sedentary life caused a constant feeling of heaviness, to relieve which he resorted more frequently to the lancet, and during the next ten years he was bled from four to six times a year, always losing from 10 to 15 ounces of blood. The frequency of the venesections increased, and for the past 40 years the patient has suffered the loss of 8 or 10 ounces of blood regularly every three weeks. For the past nine months this man has been under Dr. Sawyer's care, who has every three weeks bled him to the extent of from 8 to 10 ounces. The demand for blood-letting is shown by a dyspnœa. Repeated auscultatory examinations of the heart and lungs have failed to discover any organic disease of the former, and but slight evidence of vesicular dilatation of the latter. The history shows that, for a time, the bleedings were not actually demanded; but for many years past, in the opinion of Dr. Sawyer, it would have been detrimental, and perhaps attended with a fatal result, to attempt a reformation of the habit.

The Health of great Cities.—The relative healthfulness of some of the great cities is shown in a table recently published in a Madrid paper, which exhibits the annual mortality for each 1000 inhabitants. The numbers are these: Madrid, 65·0; Vienna, 32·7; Berlin, 30·6; Rome, 29·3; New York, 27·9; Turin, 24·8; Brussels, 24·8; Paris, 23·2; London, 22·2; Philadelphia, 20·3.

The Hair changing Colour.—It is stated that the transactions of the British Royal Society, extending over 200 years, contain no instance of any sudden change in the colour of the human hair—a circumstance regarded as conclusive that no such change has ever occurred, for, had it ever been undoubtedly witnessed, it is not likely that it would have remained undescribed. The most eminent medical writers confess themselves unaware that, irrespectively of recorded evidence, anything in support of the popular notion on this subject can be adduced on physiological grounds. It is well known that human hair cannot be injected. Using colouring fluid, such as a solution of nitrate of silver and a solution of iodine, does not produce any change of colour except in the portions actually immersed. Whether it owes its colour

to a fixed oil, to a peculiar arrangement of its constitutional molecules, or to both, it resists decay in a remarkable manner; it resists the action of acids and alkalies, except the strongest, which dissolve it; it resists maceration, and even boiling water unless for a long time applied and under pressure, when it suffers disintegration and decomposition. Exposure to the sun will bleach hair, but this will not account for any very sudden change of colour. The popular notion, however, is in favour of the affirmative of this question, and some naturalists and physiologists adduce what they regard as credible instances of hair changing to white or grey in the case of persons under strong emotions of grief or terror.

The Carbolic Spray.—Among recent surgical discoveries which lighten suffering, next to chloroform, will probably stand the carbolic spray. It is true it makes a mess in the operating room, and it necessitates that the surgeon should have an attendant, but we believe experiments in the use of it in the London hospitals prove that it is wonderfully efficacious in preventing unhealthy symptoms where the lance has been, hastening healing in an astonishing manner. Two patients, in similar conditions of health, underwent the amputation of a leg the other day in a London hospital, and as an experiment in the one case the carbolic spray was played over the part while the operation went on, and the stump was dressed in linen saturated with the fluid. In the other case the treatment was ordinary. The recovery of the patient treated with the carbolic spray was amazing in contrast with the other. All tendency to fester or to proud flesh is prevented. If such results can be relied upon, the inconvenience of operating while the spray is falling will be thought little of.

Long Life for Medical Men.—The profession of medicine and the cares of a medical practice cannot be said to be conducive to longevity. The tear and worry incidental to anything like an active pursuit of the calling is far greater than that to which members of the other popular professions — the Church and the Bar — are subject. Nevertheless we often find gratifying illustrations of how the possessor of a good constitution, who practices sobriety and regularity of living, will overcome all the influences which tend to shorten his life. A notable year for instances of longevity in our own ranks is that which has just passed away (1875). The following physicians and surgeons died during the year at the ages indicated —viz., James Dawson, F.R.C.S. Eng., 96; Peter Mere Lathan, M.D. Oxon., F.R.C.P., Physician Extraordinary to the Queen, 86; R. Stanley Ireland, M.D. Dub., Senior Fellow of the Royal College of Surgeons of England, 96; Arthur Helsham, M.R.C.S. Eng., 90; Sir Charles Locock, Bart., M.D., D.C.L., F.R.S., 77; William Beattie, M.D., F.R.C.P., Lond., 82; George Webster, M.D., and J.P. for Surrey, 79; H. M. Keble, M.D., Staff-Surgeon, R.N., 84; William Hey, F.R.C.S. Eng., of Leeds, 79; James Snow, F.R.C.S. Eng., J.P. for Lincoln, 96; Thomas Paget, F.R.C.S. Eng., of Leicester, 79; Henry Franklin, C.B., F.R.C.S. Eng., Inspector-General of Hospitals, 89; Robert Law, M.D. Dub., 76; John Jobson, M.D. Edin. 85; Andrew Morison, M.D., R.N., 89; William Macdonald, M.D., F.R.S. Edin., 84; Francis Kiernan, F.R.S., F.R.C.S. Eng., 76; H. S. Murley, M.D., 88; Henry S. May, M.D., Army, 86.—*Lancet.*

The Effects of Gymnastic Exercises. — An official inquiry into the results of gymnastic exercises has recently been instituted at

a military gymnastic school in France. The results of the inquiry, which extended over a period of six months, established — 1. That the muscular force is increased on the average, 15 to 17 per cent., and occasionally from 25 to 30 per cent., while the force has, as we might expect, a tendency to become equal on both sides of the body. 2. That the capacity of the chest is increased by one-sixth, at the lowest. 3. That the weight of the individual is increased from 6 to 7 per cent., and occasionally from 10 to 15 per cent., while the bulk of the body is diminished, thus showing that the profit is confined to the muscular system. The increase of muscular force was generally confined to the first three months of the course. During the last moiety a serious diminution usually occurred; and here the dynamometer gave positive indication of the necessity of moderating or suspending the exercises.—*Medical Examiner*.

Using old Prescriptions.—The *Lancet* comments upon a practice fraught with considerable danger to doctors, druggists, and the public generally. This is the custom of handing about old prescriptions from one person to another, and using them in season and out of season whenever the fortunate or unfortunate possessor has a mind to take a dose. Many of the prescriptions contain poisonous ingredients, and the "accidents" caused by their unreasonable use may be better imagined than described. But it is not only when they contain ingredients actually poisonous that they are likely to cause injury. A mixture which may be very harmless as applied to a rheumatic patient might be most mischievous if taken by one suffering from fever. Yet the druggist to whom the prescription is presented by an ordinary messenger has no means of knowing whether the applicant is likely to be benefited by the medicine or the reverse.

Unwilling Sleep.—A recent case of spontaneous hypnotism is described in *Les Mondes* by M. M. Bouchut. A little girl of ten had been apprenticed five months for the sewing of men's waistcoats. One day, after a month of diligent but not excessive work, and while sewing a button-hole, she lost consciousness and slept one hour. Awakening, she resumed the work, but with the same result. This hypnotism did not occur with any other work of sewing. M. Bouchut made observations on the girl; he gave her a button-hole to sew; she had hardly sewn three stitches when she sank from her chair on the ground and fell fast asleep. M. Bouchut raised her and noted catalepsy of the arms and legs, dilatation of the pupil, slowness of pulse, and complete insensibility. The sleep lasted three hours. Next day he made a similar experiment; the girl slept only one hour. While the girl was not thus affected by other kinds of sewing, M. Bouchut found he could bring on the hypnotism by getting her to look intently at a silver pencil held about 10 centimetres from the root of her nose. The case in question was evidently one of Braid's hypnotism, only occurring spontaneously, and not brought on by way of experiment.

The Force of Imagination.—Incidentally we (*British Medical Journal*) may gather from time to time curiously valuable information as to the worthlessness of subjective evidence respecting mysterious agencies. The *Student's Journal* lately published some ward notes of the impressions which patients occasionally derive from the use of the clinical thermometer. A young woman who was convalescent, and whose temperature had long remained normal, had a slight relapse, which she attributed to having had "no

glass under her arm for a week." A man suffering from acute rheumatism, obstinately refused to have his temperature taken any more, saying "it took too much out of him; it was a-drawing all his strength away." A man had been in the habit for some time of having his temperature taken daily under his tongue with a thermometer that had just been doing severe duty in the axillæ of other patients. One night, a bran new thermometer was applied to his mouth; next day he declared he was not so well, and said, "the glass was not so strong as usual; he felt at the time the taste was different, and it had not done him so much good." A sister in one of the women's wards says, that many of the patients think the thermometers are used to detect breaches of the rule against having unauthorised edibles brought in by friends; and she, accordingly, does not disabuse their minds of their innocent superstition. These "impressions" are precisely the sort of evidence on which the advocates of "metallic tractors," galvanic belts, mesmerism, and such like rely.

Food Administered by Injection.—One of the latest practical discoveries of science is the administration of food by hypodermic injection. We all know that it has been the custom for many years to administer morphia by making a small puncture in the skin and injecting a solution of morphia with a syringe, and that sleep follows almost immediately. A Vienna physician, named Kruegg, has injected fatty liquid, solution of sugar, milk, and yolk of egg in this way. This expedient enables a physician to feed a madman who refuses to take his food in the ordinary way. We see no reason why the same expedient should not be adopted where there is a difficulty in swallowing food, in cases of sore throat, for instance.

The Stomach Pump for Stomach Diseases.—In Germany, disturbances and diseases of the stomach are now treated by means of the stomach-pump. The value of this instrument, as we gather from the clinical *Wochenschrift*, published at Berlin, has been demonstrated in almost all gastric affections, in phthisis and in cancer. Pure tepid water is pumped into the stomach, and pumped out again, whereby the interior is cleansed and soothed. In some cases medicaments are mixed with the water. For example—bicarbonate of soda when the reaction of the gastric fluid is very acid; permanganate of potassa when the fluids show signs of decomposition; carbolic acid when there are vegetable parasites; boracic acid as a disinfectant, and tincture of myrrh in atomic dyspepsia accompanied by abundant production of mucus. In the United States it has been found that the stomach can be as readily filled and emptied by means of an india-rubber syphon as by the stomach-pump.

Tablespoons and Teaspoons.—A correspondence on a subject of great practical importance has recently been going on (says the *Lancet*) in the *Pharmaceutical Journal*. Mr. Proctor, of Newcastle-upon-Tyne, has pointed out some striking instances of the inconvenience and danger that may arise from the want of uniformity that at present obtains among medical men respecting the relative proportions of one tablespoonful and half an ounce. Modern tea and table-spoons are much larger than those employed forty or fifty years ago, so that a tablespoonful should no longer be taken as representing half an ounce, nor a teaspoonful as equivalent to one drachm. As a fact, however, there is a large number of prescribers, who, when they order half an ounce of medicine to be taken, mean by that one

tablespoonful, and *vice versâ*, while a few medical men regard half an ounce as equal only to a modern dessert spoonful. It is clear, therefore, that something should be done to ensure a common standard of measurement; and as teaspoonfuls and tablespoonfuls will doubtless always continue to be most frequently employed for the purposes of dealing out doses of medicine, it would be well, as Mr. Martindale has suggested, to give a higher value to these measures. A tablespoonful is now really equal to between five and six drachms, and the tea-spoon is capable of holding from eighty to eighty-five drops, while the dessert-spoon in present use comes up to nearly half an ounce. In ordering drugs in mixtures, and especially powerful or poisonous ones like strychnine and arsenical solutions, one tablespoonful should be looked upon as equal to six drachms, the dessert-spoonful to four drachms, and the teaspoonful to a drachm and a half. A twelve-ounce bottle would, according to this, contain eight doses of two tablespoonfuls each, an eight-ounce bottle five similar doses, and a two-ounce bottle about eleven teaspoonful doses.

Upon the same subject *Land and Water* remarks:—The time-honoured custom of measuring doses of medicine by tablespoonfuls, teaspoonfuls, and drops has received a rude shake [illegible] the *British Medical Journal* by Dr. R. Farquharson, and by Mr. Proctor in the *Pharmaceutial Journal*. It is found that modern table and teaspoons are much larger than they were formerly, and that a tablespoon of the present day contains considerably more than half-an-ounce. So, also, the teaspoon is no longer equivalent to a drachm. The size of a drop has not, of course, altered, but a drop is seldom, if ever, exactly equivalent to a minim, although it is assumed to be so. Much depends on the fluid, and not a little on the shape of the bottle from which it is dropped. As a rule the minim is considerably more bulky than a drop, and thus, when medicine is dropped instead of being measured in a minim glass, the patient's doses are smaller than they should be. It would, without doubt, be much better if domestic dispensers of medicines would use graduated measures instead of spoons or drops for measuring the doses of their patients, but, as there is little chance of their doing so universally, the next best thing is to ascertain what the actual contents of "spoonfuls" really are. The average contents of tablespoons now in use equal from five to six drachms; the dessert-spoon holds nearly half-an-ounce; and the teaspoon from eighty to eighty-five minims. Another useful measure for domestic purposes is the wine-glass, but this varies in its contents from two ounces and a-half to three ounces and a-quarter. These measures are, perhaps, sufficiently exact when ordinary medicine only is used, but when powerful and dangerous drugs are administered the only safe plan to adopt is to measure carefully into a graduated glass.

Can one be Anæsthetised during Sleep?—In the *Annals de Hygiène*, Professor Dolbeau describes various experiments made by him to ascertain whether a person can be anæsthetised during sleep. He mentions the cases of three patients who, while sleeping, were readily aroused by applying small quantities of chloroform at no great distance from the nostrils. In another series of experiments, made on seven patients, ten drops of chloroform were poured on a napkin folded in four, which was gradually brought into the vicinity of the air-passages, so that all air inspired had traversed it. In all these cases the patients were suddenly aroused from their sleep, some immediately, and only

one after the eleventh inspiration. A third group of cases consisted of twenty-nine patients. It was found that in ten out of this number, that is, in more than a third, complete anæsthesia could be induced without awakening them. Dexterity in the mode of procedure seemed to have something to do with the proportion thus obtained, as it increased progressively with the number of cases experimented upon.

The Cure of Wounds.—A Venetian surgeon, Dr. Minich, has published a *brochure* on the antiseptic cure of wounds, in which he advocates the employment of sulphate of soda in dressing of wounds (and also against erysipelas), in preference to phenic and salicylic acid. It is much cheaper and not attended by the inconveniences of these acids. He uses one part of sulphate in nine parts of water, adding one part of glycerine. Dr. Minich shows that happy results have been obtained by this method in Venice in a large number of cases.

Chloral again.—The popular appreciation of chloral, with its effects, says the *Lancet*, for a time so delightful, and ultimately so delusive, will not be lessened by an account, copied by a contemporary from *Galignani*, of the virtues of this hypnotic. According to Dr. Papillaud, whose paper read before the Academy of Medicine is the basis for the account, chloral is a remedy of almost universal use, and almost unlimited power. Two cases of lock-jaw under his care, and six under that of Dr. Verneuil, have yielded to its influence. In small-pox it has permitted, if not caused, recovery. In pleuro-pneumonia it is equally useful. But its greatest, most precious, and it must be admitted, most permanent effect is to be found in its power of soothing the last sufferings. "A dying person may thus be spared the physical and moral sufferings of his approaching decease. A consumptive girl, by the administration of chloral, died without pain, instead of wrestling uselessly with asphyxia." Unquestionably sedatives have a place in the treatment of disease of the highest importance, but their use needs careful regulation, and the agony of death can rarely be assuaged except by accelerating its course and hastening its end. Our feelings and belief forbid us to obscure consciousness during the last moments of life, and still more do they add fresh force to the continued validity of the sixth commandment, without a violation of which the euthanasia can hardly be actively secured.

Real and Apparent Death.—Dr. Ange-Monteverdi suggests as an easy, prompt, and certain method of distinguishing real from apparent death, the subcutaneous injection of a small quantity of liquor ammoniæ, the strength of which should be considerable. When injected into the living body, even during the last hours of life, ammonia causes the appearance of a spot of a deep red or purple colour, which forms more or less quickly according to the rapidity of the circulation. If the fluid be injected after death, no change in the colour, or only a darkening of the skin's natural colour, is produced. If injected into the skin of a person in perfect health, a severe burning pain is experienced, and a small blister rises in the centre of the spot. Dr. Ange further says of his test, that no harm beyond the formation of a small eschar appears to result from the injection, and all traces vanish in the course of a fortnight.

How Hydrophobia is treated in China.—Hydrophobia is treated in a highly original manner by the Celestial medicos. Two sandstone bottles half filled with wine or spirit are placed upon the fire until the liquid boils. The con-

tents are then emptied, and the red hot mouth of the bottle is applied to the bite and held there till it is filled with blood, when the same process is gone through with the other bottle. A decoction is then made of a kind of glutinous rice, called *kian-mi-ou-lou*, and used for fermenting wine, in which seven cantharides are boiled. The flies are taken out, and the rice is given to the patient, who is afterwards kept perfectly quiet.—*Graphic*.

Artificial Eyes made Sensitive to Light.—Among the curious developments of science is the recent production, by Dr. C. W. Siemens, of an artificial eye that is sensitive to light. We wish we could add that it gives vision to the blind; but we cannot, though perhaps it contains a germ of promise in that direction. The new eye is composed of an ordinary glass lens, backed by an artificial retina of selenium. This mineral resembles and is allied to sulphur; it is distilled from bodies that contain sulphur in conjunction with metals, such as iron pyrites, a compound of sulphur and iron. Mr. May, a telegraph clerk employed at the Valentia station of the Atlantic cable line, first observed, in 1873, that the electrical resistance of selenium was instantly altered by light, the resistance being diminished by increase of light. Dr. Siemens made use of this peculiarity of selenium in the construction of his novel eye. An electrical circuit is arranged, of which a bit of selenium forms a part, and constitutes the retina. When a strong light is admitted into the lens and falls upon the selenium retina, the current of electricity flows and (by acting upon small magnets) may be made to work the artificial lids of the eye, opening or closing them according to the intensity of the light. It is well known that the vibrations of musical sounds may, by an ordinary conducting wire, be electrically transmitted and successfully delivered to the ear. It remains to be determined whether light vibrations can, by means of selenium and electricity, be transmitted to the brain in the absence of the natural eye.

Snake Bite.—The report of a special committee of the Medical Society of Victoria is entirely adverse to the use of the intravenous injection of ammonia in the treatment of snake poisoning. Their experiments entirely confirm the negative results of Indian experimenters; and Dr. M'Crea expressed the opinion at the society that to continue the intravenous injection of ammonia was to trifle with human life.—*British Medical Journal*.

Curing a Cough.—An Italian (according to *Les Mondes*) attributes cough to the presence of a parasitic fungus in the air passages. In grave cases, this parasite multiplies, and reaches into the lung cells. Quinine has the property of stopping the development of microscopic fungi, and is therefore adapted as a remedy in the present case. The following powder it is said has been used with success: Chlorhydrate of quinine, 0g. 10c.; bicarbonate of soda, 0g. 10c.; gum arabic, 2g. 0c. The bicarbonate of soda is meant to dissolve the mucus, the gum arabic to increase the adherence of the powder on the bronchial passages. The blowing in of the powder should take place during a deep inspiration of the patient, so as to facilitate its penetration into the windpipe, which is the principal seat of the microscopic fungus.

To Extract Foreign Bodies from the Ear.—Mr. G. P. Field describes in the *British Medical Journal* a successful and safe method of extracting substances from the ear:—"A great deal more harm than good is often done by the use of instruments; but by the following method no injury can be caused. Place the patient under

chloroform, with the ear affected downwards, and syringe from below. Pull the auricle backwards and upwards (by this means the external auditory meatus is made into a straight tube), and apply the nozzle of the syringe to the upper wall of the passage. The water is then gently forced behind the obstruction; the foreign body is loosened, and its own weight will cause it to fall out of the ear. I have removed all kinds of substances in this way." Omitting the chloroform, this operation may be performed by the domestic "surgeon."

What is a Disinfectant?—It has been erroneously supposed, writes Dr. J. E. Loughlin, in the *American Chemist*, that the action of a disinfectant consists in the coagulation of the albuminous principles which are prone to change. This would be reasonable if the disinfecting action of compounds depended upon their use in large amounts, but this is not so; fifty grains carbolate of lime will prevent putrefactive change in one pound of blood for five or six days, yet the amount of carbolic acid contained in the disinfectant is not capable of coagulating the 560 grains of albumen in one pound of blood. The true action of a disinfectant, such as carbolic, cresylic, or salicylic acid, is its property of destroying the animal or vegetable germs that produce decomposition by their presence, or, secondly, by their direct power-destroying tendency to molecular change in the parts of albumen exposed to germs.

The Abuse of Narcotics.—The vast abuse of narcotics in modern society is becoming a serious evil. There is no denying the fact that in countries where no administrative control of chemist's shops exists, as in England and America, the public has too easy access to such drugs. It is not long since a political weekly contemporary boldly contended that chloral was to be found in the workboxes and baskets of nearly every lady in the West-end "to calm her nerves." Chloral punch had become an "institution" in the drinking saloons of New York scarcely a year after its introduction into medical practice. Now we hear from sober, orderly, and paternally ruled Germany that there is such a thing as morphia disease spreading amongst its population. Our contemporary gives an alarming account of the mischief, moral and physical, which arises from excess in the use of narcotics.

Poisoning from Lead in Vegetables.—Dr. D. De Loos, of Leyden, writes (says the *British Medical Journal*) in the *Weekblad van het nederlandsch Tidjschift voor Geneeskunde* that he was consulted in October last regarding certain symptoms of paralysis and nervous disturbance, which suggested the idea of lead poisoning. The symptoms occurred in a family residing in the neighbourhood of a place where a manufactory of white lead had stood twelve years previously; they made use of vegetables growing on the spot. In order to make it certain that the poisoning was produced, as he believed it to be, by the vegetables, Dr. De Loos examined chemically some red beet, endive, and carrots, and ascertained the presence of lead in all. In a beet weighing 650 grammes, he found the equivalent of a centigramme of metallic lead; in six carrots, weighing altogether 272 grammes, there were 1¾ centigrammes of metallic lead; and the metal was also found in the endive. The ashes of the plants also contained traces of copper, which had probably existed as an impurity of the lead.

The Frequent Nip.—It is becoming the custom, we (*Medical Examiner*) hear—not so much, perhaps, in London as in other seats

of commerce, such as Liverpool, Manchester, Birmingham, &c.—to seal most business transactions with "a drink," which varies according to circumstances, from "the pint of bitter" to "the bottle of sparkling." It is further stated on reliable authority that this custom is equally in vogue at all hours in the day. The partners in large houses do not, perhaps, put the finishing touch to their transactions in the open way that their juniors do, but the bottle of sherry and the tin of biscuits are generally close at hand in the private office, and are called into requisition more frequently than is either necessary or expedient. This habit is one against which we cannot too strongly inveigh. So far as health is concerned, it is more than probable that small but repeated doses of alcohol do far greater injury to the tissues than larger quantities, such as those taken by the working man when Saturday night comes round. The experience of most physicians would probably be that the patient whose health has been most wrecked by drinking is the man who has been in the habit of taking frequent sips of liquor. Such men will often boast that they have never been drunk in their lives, but their livers are nevertheless hopelessly "hob-nailed" from alcohol. It would be sad to see such a result arising amongst our young business-men from the friendly but deleterious habit of the "frequent nip."

A General Antidote for Poisons.—M. Jeannel gives the following formula for an antidote for a number of deadly poisons:—Solution of sulphate of iron (D. 145) 100, water 800, calcined magnesia, 80, washed animal charcoal, 40. These ingredients are kept separate, the solution of sulphate of iron in one vessel, the magnesia and charcoal in another, with some water. When needed, the sulphate solution is poured into the last-mentioned receptacle and violently agitated. The mixture should be administered promptly in doses of from 1·6 to 3·3 ounces. From experiments M. Jeannel finds that this antidote, employed in proper proportions, renders preparations of arsenic, zinc, and digitaline completely insoluble. It does not render oxide of copper absolutely insoluble, however, and leaves in solution notable quantities of morphine and strychnin. It neither decomposes nor precipitates cyanide of mercury nor tartar emetic. It saturates free iodine entirely, and acts but partially upon solutions of alkaline hypochlorites. Four ounces of the antidote are found to neutralise the poisonous effect of 1·6 ounces of arsenite of soda. It retards the toxic action of sulphate of strychnin, affording sufficient delay to administer evacuants. One-third of an ounce is efficacious against digitaline injected into the intestines. The formula, says M. Jeannel, is certainly preferable to the officinal hydrated peroxide of iron, which, in course of time, and at a temperature of 59° Fah., undergoes molecular modifications which render it unreliable as an antidote for arsenical preparations.

Dying of Old Age.—Majendie pointed out to Dr. Farr at Saltpetrière, the hospital for old people in Paris, that the deaths apparently from no cause were often the result of pneumonia, or consolidation of the lungs, which in the absence of the ordinary symptoms could be detected before death by dulness of the chest on percussion. Hippocrates had noted that the symptoms of disease grew obscure in advanced age. And this must be so. The symptoms of disease—including pain itself—require strength for their manifestation; without it reaction

is scarcely appreciable; and many diseases in the old as well as in the young are so insidious as to escape detection. But, upon the other hand, many deaths due to debility are ascribed to specific diseases. "And beyond doubt," remarks Dr. Farr, "thousands do die of old age; thousands like the patriarchs of old, fall asleep. As the body with all its parts is undergoing continual renewal, it grows, gets consciousness, develops strength for years, and then all its powers insensibly decline, until the daily alternations from wakefulness to sleep of which life is made up cease; and it is all sleep; the life exhales in the arms of friends, or alone in the night, like a light going out. This last end is the natural death to which, as Bacon says, it is the office of the physician, of the State physician we say, to conduct the nation."

Medical Relief in Scotland.—The *British Medical Journal* calls attention to the startling fact that, in Glasgow, 25 per cent., in Paisley, 22 per cent., and in Dundee and Greenock, 41 per cent. of the population are unprovided with medical aid during their last illness. In Whitechapel, only 1 per cent. are uncertified; in Liverpool, only 4½ per cent.; and in Edinburgh, 6 per cent. Tracing out the causes, the *Journal* attributes them to the insufficiency of the Poor-law medical relief in Glasgow, there being but a small staff of Poor-law medical officers, and these badly paid. The dispensary and hospital accommodation in Glasgow is also below the mark of other great towns, and the legal and charitable provision for the attendance of the indigent poor is very insufficient. The following figures indicate the disparity between three great towns.—Sick poor attended at home in Glasgow, per 1000, 29; in Edinburgh, 43·6; in Liverpool, 40·2; attended at dispensaries, in Glasgow, per 1000, 55; in Edinburgh, 43·6; in Liverpool, 40·2; attended in hospital, in Glasgow, per 1000, 12·6; in Edinburgh, 25·2; in Liverpool, 14·6.

The Earth Treatment for Ulcers.—The dry earth treatment for ulcers is found quite successful. Large, sloughy ulcers, after being washed, are covered with a thick layer of earth, over which wet paper is placed as a support, the whole being neatly bandaged. In a few days the ulcers begin to clear, and when the surfaces look healthy and granulating, a dressing made as follows is used:—A piece of muslin the size of the ulcer is immersed in carbolic oil, in the proportion of one part acid to ten parts cocoanut oil; with this the sore is covered, and over it dry earth is placed, and then moistened earth and a bandage. In a short time the healing process manifests itself satisfactorily, while all odour is entirely removed.

The Marriage of Near Kin.—M. Saint Martin, of Madrid, has published some statistics (says the *London Medical Record*), which tend to prove that consanguineous marriages have but a very slight influence in producing the ill effects which have been generally ascribed to them. The results of his figures are as follow:—Out of 161 consanguineous marriages twelve were childless. The remaining 149 unions had produced 551 children, out of which 300 were in good health, 236 were dead, and fifteen sickly. The latter showed the following affections:—five deaf and dumb, two idiots, six scrofulous, rachitic, or tuberculous, and two hemiplegic.

Poisons in Austria.—The Austrian Government has lately published an order relating to the traffic in poisons, in which the following substances are designated as of this class:—1. Arsenic, and all compounds containing arsenic. 2.

Compounds of antimony with chlorine and oxygen. 3. The oxides and salts (including chlorine, bromine, and iodine compounds) of mercury. 4. Ordinary phosphorus. 5. Bromine. 6. Prussic acid, and the preparations containing it; also all cyanogen metals, those only excepted which contain iron as constituent. 7. The powerfully acting preparations obtained from poisonous plants and animals, or produced artificially, such as the alkaloids, curare, cantharidin, &c.

A Case of Poisoning by Chloral.—An interesting account is furnished by Dr. Young, of Florence, to one of the foreign medical journals, of a case of poisoning by chloral hydrate, and the complete cure of the victim by very simple means. A gentleman took a whole mixture, containing three drachms of the salt, instead of the sixth part, as ordered. He was in a condition approaching lifelessness when the doctor arrived, but by the prompt application of hot-water bags and bottles to the stomach and other parts of the body, wrapping the legs in warm flannel, and the administration of extract of meat with a little brandy after the heart began to show evidence of regaining its power, the patient was at last completely restored.

A curious Psychological Phenomenon.—A psychological phenomenon has been reported by a medical man in Bordeaux. A woman, Felida X., has for sixteen years been undergoing an alteration of memory, which has all the appearance of a doubling of life. There is amnesia, or loss of memory, with regard to periods of variable duration which have gradually been enlarging. The memory, passing over these second states, connects together all the periods of the normal state, so that Felida has, as it were, two existences—the one ordinary, composed of all the periods of the normal state connected by memory; the other secondary, comprising all the periods of the two states—that is, the whole life. The forgetfulness is complete and absolute, but refers only to what has happened during the second condition; it affects neither anterior notions nor general ideas. Besides amnesia, Felida manifests, in the periods of attack of the malady, changes in character and sentiments. The alteration of memory and accompanying phenomena have for cause (the author says) a diminution in the quantity of blood conveyed to the part of the brain, still unknown, where memory is localised. The momentary contraction of vessels, which is the instrument of this diminution, is caused by the state of hysteria.

In Cases of Sunstroke.—The following remarks on the subject of sunstroke are extracted from a paper by Sir Joseph Fayrer, M.D., who has had an extended experience of its effects in various parts of the world:—

In cases of simple exhaustion ordinary treatment is all that is needed. Removal to a cooler locality, the cold douche (but not too much prolonged) or the administration of stimulants, may be beneficial. Tight or oppressive clothing should be removed, and the patient treated as in syncope from other causes. Rest and freedom from exposure to over-exertion, fatigue, or great heat, should be enjoined.

In that form of sunstroke where the person is struck down suddenly by a hot sun, the patient should be removed into the shade, and the douche of cold water being allowed to fall in a stream on the head and body from a pump (or as in India from the mussuck or other similar contrivance), should be freely resorted to, the object being two-fold —to reduce the temperature of the over-heated centres, and to rouse them into action.

During the assault on the White House piquet in the last Burmese war, numbers of men were struck down by the direct action of the sun during the month of April. They were laid out perfectly unconscious, in their red coats and stocks (they wore them in those days, 1852), but were recovered by the cold douche freely applied by the mussuck over the head and body. In some cases, rousing by flagellation with the sweeper's broom was added; and all recovered with the exception of two cases, both of which had been bled on the spot where they fell. Mustard-plasters and purgative enemata may be useful.

If recovery be imperfect and followed by any indication of injury to the nerve-centres, or by the supervention of meningitis, other treatment may be necessary according to the indications. Much exposure to the sun should be carefully guarded against; and, unless recovery be complete and rapid, the sufferer should be removed to a cooler climate, the most perfect rest and tranquillity of mind and body enjoined, and the greatest care be observed in regard to extreme moderation in the use of stimulants.

Dosing Animals with Arsenic.—Some interesting experiments on the localisation of arsenic in the tissues of poisoned animals are described by M. Scolosuboff in the *Bull. Soc. Chim.* It appears that dogs can absorb without danger about sixteen times as much arsenic —in proportion to their weight—as would kill a human being. M. Scolosuboff's experiments also prove that arsenic first accumulates in the nervous system, and then passes to the liver and muscles.

Swallowing a Fork.—A remarkable surgical case has lately been described to the French Academy by M. Labbé. A youth of eighteen, who sometimes amused his friends by pushing a fork into his throat, on one occasion let go his hold of it (being startled by some pleasantry). The fork was buried deeply in the pharynx, and all efforts to catch it were in vain. It soon went deeper, and there were signs of asphyxia, but the youth was ere long relieved by its passing into the stomach. He went about with it for some six months, suffering at intervals extreme pain, but at other times pursuing his usual occupation. At length, however, the suffering was so great that an attempt at extraction seemed imperative, and M. Labbé undertook it. He first tried caustics, but unsuccessfully; and he then had recourse to incision. The operation succeeded, and the fork was removed. M. Labbé took great precautions in the way of determining very exactly the points to be attacked, fixing the stomach to the abdominal walls before opening it, and employing a very thick layer of collodion, after operation, so as to render immovable the abdominal walls and the digestive tube, subjecting them at the same time to strong compression. The patient rapidly revived, and on the fifth day was able to take his ordinary diet. The fistula, or aperture remaining, is hardly so large as to allow the entrance of the little finger. —*English Mechanic.*

Watch-ticking Experiments.—In the German Medical *Centralblatt* attention is called by M. Urbantschitch to the fact that if a watch be held at a little distance from the ear, the ticking is not heard uniformly, but there is a swelling and diminishing of the sound. If held at such a distance as to be scarcely audible, the ticking will come and go, being at times perceived distinctly, but at other times becoming wholly inaudible. This variation in perception is not always gradual—it is sometimes sudden. The same holds good for other weak sounds, as that of a weak water jet

or a tuning fork. Since breathing and pulsation have not the least influence on the phenomenon, the author considers the interruptions of the sensation must be attributed to the organ of hearing itself; our ear is unable to feel weak acoustic stimuli uniformly, but has varying times of fatigue. To decide finally where the seat of the peculiarity lay, M. Urbantschitch made both ear-passages air-tight, and applied a tuning-fork and a watch to the head. The sounds seemed not continuous, but intermittent. The cause must therefore be in the nerves of hearing.

Diseases of the Nervous System.—According to the Registrar-General's annual report for 1873, the annual death-rate for diseases of the nervous system—including cephalitis, apoplexy, paralysis, insanity, epilepsy, and brain disease not otherwise described—was equal to 1424 per million living in the five years 1850-54, and increased to 1447, 1547, and 1612 in the three succeeding quinquennials. During the last four years for which this information is available (1870-73) the rate further slightly increased to 1665 per million living. This shows an increase of about 15 per cent. in the death-rate from these diseases in twenty years, which bears but a small proportion to the increase in the number of inmates of lunatic asylums in the same period.

The Fumes of Pitch for Whooping Cough.—During the trial of a cause in one of the law courts recently it was stated in an affidavit that the medical men of Hyde and neighbourhood had within a month sent about forty children to a chemical factory to inhale the fumes of pitch, as a remedy or palliative for whooping cough.

How to Arrest Palpitation.—A correspondent in *L'Union Médicale* calls attention to the fact that palpitations, when not depending upon organic disease, may be almost immediately arrested by bending the head downward and allowing the arms to hang pendent. The effect is even still more rapidly produced by holding the breath for a few seconds while the body is in this bent position.

Stimulants in Fever.—A writer in the *Dublin Medical Journal* concludes that in the treatment of fever—typhus and other forms—too much reliance has been placed on alcoholic stimulants; that the percentage of cases requiring such stimulants is a low one; and that, while the administration of them, as regards quantity and kind, must depend entirely on a patient's condition, the utmost caution, with what is known at present of their physiological action, is required. Digitalis, however, affords a powerful cardiac stimulant, which, while it gives force to the heart, does not do so at the expense of the system, but rather is a conservative agent which controls expenditure and limits waste of vital action; it being, nevertheless, always the case, of course, that a large number of recoveries will occur without any specific treatment, save that care and guidance which provides for the wants of the system without introducing complications.

A Specific for Cold in the Head.—All praise to Dr. David Ferrier, assistant physician at King's College Hospital. He has discovered a specific for cold in the head. Being himself much subject to that very unpleasant though not alarming disorder, he tried what bismuth would do for him. He took repeated pinches of it as though it were snuff, inhaling it strongly, so as to carry it well into the interior of the nostrils. In a short time the tickling in the nostrils and sneezing ceased, and next morning all traces of coryza had completely disappeared. Renewed experiments upon himself

and others confirmed his belief in the efficacy of this remedy, and he has described it at length in the *Lancet*. He finds the most suitable formula as follows:—Trisnitrate of bismuth six drachms, acacia powder two drachms, hydrochlorate of morphia two grains.

Bullets and Brains.—The manager of a New Jersey paper has for the last seven months been known as "The Editor with a Bullet in his Brain." He was shot in his own office in March, 1875, and recovered so completely, says the *Lancet*, that his assailant was released on bail, but he relapsed and died on the 24th of Oct. A post-mortem examination was made, and "the bullet was found encrusted within the tentorium, beneath the posterior lobe of the right hemisphere." Three abscesses were found on the right hemisphere, there was marked congestion of the pia mater on the floor of the right ventricle, especially on the right side: the cerebellum was wholly uninjured. The opening (made by the bullet) was an inch to the right of the occipital protuberance, and half an inch above the groove of the right lateral sinus.

The Effect of Acid Vapours on Health.—Dr. Angus Smith, in his eleventh annual report of proceedings under the Alkali Acts, just issued, gives, says the *Lancet*, some interesting information on the influence of acid vapours on health. Among other observations, the inspector says it may be taken for granted that where trees flourish there also man is uninjured by acids such as are given out by chemical works, the effect on vegetation being more striking than upon human beings. The conclusion is that gases from chemical works are hurtful to the health; nor can they, on the other hand, be said to be curative in certain diseases, as so many suppose. In collating the statistics of a district peculiarly exposed to the fumes from alkali works, Dr. Smith was struck with the following points:—1. That bronchitis was not high. 2. That scarlet fever, which gases might be supposed to disinfect, was very high; whilst whooping-cough, often thought to be benefited by the fumes, was low.

A New Cure for Rheumatism.—Salicin is not the only remedy which is now being used in cases of acute rheumatism. Another is being adopted. Unfortunately, it bears the formidable name of "trimethylamine." True, it has an *alias*, but "propylamine" is not much better. This drug is derived from herring brine, and the accounts given of its effects upon the disease in question are very remarkable.

A Remedy in Diphtheria.—Dr. Hopkins, in the *Physician and Pharmacist*, strongly urges the employment of acid tannate of iron as a local remedy in Diphtheria. It may be prepared, he says, by the addition of one ounce of the muriated tincture of iron to one of a strong solution of tannin, and applied by means of a brush to the diseased throat, or elsewhere as the case may be; or, what is perhaps a still better way, apply the muriated tincture of iron in full strength to the diseased part with a brush, wait a few moments, then apply the solution of tannin in the same way, thus forming a union of the two at the point of disease, having at the same time the advantage of chemical action, if there be any. On examination a few hours after, the line of demarcation will be seen distinctly drawn by the discoloration of the diseased tissue, showing exactly the extent of the disease, the very thing desired; with a tendency to reparation, which will go on rapidly, if the system be properly treated with a nourishing diet and tonic and stimulating remedies. Dr. Hopkins regards this remedy as "above and before all others."

The Dangers of Cleanliness.—What with doctors and sanitarians the man of the nineteenth century bids fair to be driven into a state of primitive savagism. Whatever we eat or drink somebody enjoins us to avoid, and now the physicians of New York have "concluded" that a terrible amount of disease is occasioned by the use of soap. Not only, we are told, has the diphtheria prevalent amongst washerwomen been traced to impurity in this popular detergent, but lung fever and kidney diseases in adults and many other complaints in children. The cause suggested is the impure condition of the fats used in the manufacture; and toilet soaps, in which the impurity may be masked by perfumes, are reported to be the worst. It would be well that our analysts should turn their attention to this matter, if that which is popularly regarded as a chief agent in promoting health has really become an important source of disease.—*Iron.*

Growing Thin by the Seaside.—The *Paris Médicale* discusses the treatment of obesity by the administration of sea-water, combined with a residence at the seaside. Sea-water, taken internally, acts like diuretic and purgative salts, a remarkable fact being that the diuretic effect increases when the purgative diminishes. The water should be obtained, when posssible, from some depth, and far from the shore. It is then to be left to settle for six to twelve hours, and filtered. It is to be taken three times a day in doses of a small tumblerful, or in half that quantity at a time with fresh water or milk. It is stated as a fact that sea-water thus used faciltates the oxygenation of the blood, and that it hastens the elimination of effete materials. In combination with this treatment sea-water baths are to be taken, free exercise is to be carried out, and at the same time fattening foods are to be avoided. Cases which have resisted other measures have been known to yield to this treatment.

The Virtues of Salicylic Acid.—It would seem as if salicylic acid were going to take the place of tar-water as a universal medicine. Only the other day it was stated to be a safe, certain, and rapid remedy for rheumatism. Now news reaches us that it is a cure for cholera. It has already been used with great success in India, where doses of eight grains were administered hourly or oftener. A medicine which cures both cholera and "the rheumatics" ought to be looked after by the profession. The drug hitherto has been almost despised; now it is being tried as a remedy for everything, from rheumatism to dysentery and low fever.

Making up Prescriptions.—Very startling revelations are contained in a report lately issued by the borough analyst at Sheffield. It states that as considerable anxiety existed as to the care and accuracy of druggists in making up physicians' prescriptions, the inspectors of the Health Department presented to certain local druggists various prescriptions written by qualified men. The prescriptions were so arranged that each should include a full dose of some expensive remedy capable of ready and accurate estimation in a mixture. A series of these samples in which 120 grains of iodide of potassium were prescribed were found on analysis to contain 122, 120, and 76 grains respectively. The last was, therefore, made up with hardly two-thirds of the active ingredient ordered—a grave departure from the prescribed amount. Of three samples which should have contained 16 grains of sulphate of quinine, one contained 9½ grains, or less than two-thirds of the prescribed amount. Another sample which should have

contained 40 grains of sulphate of quinine had but 30 grains. Of 12 samples of glycerine, only five were pure and of the standard. Two other samples were somewhat below the official strength, containing six and 8·5 per cent. of water respectively, but were otherwise pure. Two others were adulterated with 11 and 12 per cent. of water. Two were of full strength, but contained lime and some non-volatile organic impurity. Another sample contained a small quantity of sugar. Three samples of citric acid were found to contain a trace of lead; but in other respects they were perfectly pure. With reference to 11 samples of pepper, Mr. Allen states that nine were genuine, and two were adulterated in some degree with pea-flour and rice.

A Cheap Spray Producer.—The want, more especially amongst the out-patient departments of hospitals and dispensaries, of an efficacious but inexpensive apparatus for the application of remedies in the form of spray in affections of the throat and chest, has induced Mr. A. Hodgkinson to construct a spray-producer, which, after a thorough trial, has, he states, been found to satisfy the above requirement completely. The apparatus, though extremely simple, and, therefore requiring no descriptive explanation, is alleged to possess the following advantages over other spray-producers: 1. Moderation in cost; 2. Accuracy as regards quantity of liquid dispersed, five minims or three drachms being distributed with equal exactitude, and thus allowing of the safer use of concentrated solutions, as morphia, &c., in certain distressing laryngeal affections; 3. The comparative ease with which the liquid is dispersed, owing to the curved form of the tube obviating, as far as practicable, the counteracting effect of gravity to the rise of the liquid in the smaller limb. This form of tube also ensures the complete use of all the contained fluid, thus avoiding waste of drugs. When cost is of no great importance, a hand-ball can be adapted to the straight tube, thus obviating the necessity of a second person.

A new and Effective Deodoriser.—Dr. Goolden, in a recent paper in the *Lancet*, recommends nitrate of lead as a most effective deodoriser. Bad smells from any cause whatever are removed as if by magic by its use. A pound of the material, costing less than a shilling, and in combination with common salt, furnishes sufficient to make nearly 400 gallons of fluid, so that it is also remarkably cheap. To prepare it for use, take for ordinary purposes half a drachm of nitrate of lead, dissolve it in a pint or more of boiling water, dissolve about two drachms of common salt in a pail or bucket of water, pour the two solutions together, and allow the sediment to settle. A cloth dipped in this liquid and hung up will sweeten a fœtid atmosphere immediately. The value of such a discovery for many purposes, medical as well as domestic, is incalculable.

Physic in Food.—Watercress has long had the popular reputation of being a powerful antiscorbutic. Probably, all the *Cruciferæ* equally deserve the title. M. Dupuy says that the plant contains an essential oil, of which sulphur forms a constituent, and that he has also discovered in cress, iodine, iron, a bitter extract, and phosphorus. He therefore adds these minerals to the soil, to increase the quantity in the plant, and then prepares a *succus*. He has established cress-gardens for the culture of this plant, in order, he says, to "vegetalise" the minerals which give it such important properties. This reminds us that long ago an Italian writer proposed to obtain iodised milk for his patients by feeding cows on hay sprinkled with potassium iodide. It may be

doubtful if the cows would like the flavour. More recently, an English writer has stated that the cows on the island of Ushant, off the coast of Brittany, feed principally on sea-weed, and that, consequently their milk is particularly rich in iodine, as it does not produce the constitutional disturbance that often results from the admixture of iodine in other forms. Last of all, it has been reserved for a French physician to iodise eggs by electricity. The arrangement employed may be readily understood when we say that he conveys the iodine into the egg by what we may call electrolysis. By any of the above methods, physic may be put in the food of invalids in an agreeable form.

A Simple Treatment of Diabetes.—The motto, "Shut your mouth and save your life," has received a new application, for Dr. Charteris, of the Glasgow Royal Infirmary, has communicated to the *Lancet* two cases benefited by a simple treatment he learned from a confirmed diabetic, who discovered it after this wise. He found that he commenced to wheeze when he breathed the cold air, and that it ceased on his return to a warm room. On putting his head below the bedclothes a slight perspiration came upon him, the saliva returned, and his tongue and mouth became moist, instead of dry as formerly. When he withdrew his head again, and breathed in the open air his mouth and tongue again became dry and parched. This moistness and dryness of the mouth alternately occurring under the conditions mentioned having arrested his attention, the question arose in his mind, how could this moisture be obtained without remaining in bed? To accomplish this he put on a respirator, and also a knitted woollen cloth over both the respirator and his nostrils when in the house, or even in bed, and was careful in protecting the nostrils as well when he went out. He also began to practise breathing by the nostrils alone, and found that breathing exclusively in this manner day and night, except when engaged in conversation, was highly beneficial.

Having perfected himself in respiring by the nostrils alone, he laid aside both the respirator and the cloth, only muffling himself carefully up when he went out at night or in frosty weather. He avoided going out at night as much as possible, and refrained from all cold diet or drink, invariably taking them warm. Under this treatment an amendment was apparent in less than fourteen days, and in less than a month it was very marked.

This patient now lives like any other temperate man, and, being a very intelligent person, has formed his theory in regard to the treatment. Briefly expressed in his own words, it is this :—"Hitherto the attempt has been made to prevent production of sugar by giving a non-saccharine diet. This is no doubt perfectly correct, but in addition to this the treatment I adopted was intended to promote the consumption of sugar produced. This design of consuming sugar by breathing through the nostrils in warm weather or by means of a respirator, is that when the proper quantity of sugar has been consumed, the abnormal production will then cease. The aim of this treatment is to raise the blood-heat to its proper temperature, and to restore to the lungs their partially lost combustive power, and so enable them to consume as much secreted sugar as will maintain the blood at its proper temperature. When that purpose is accomplished the organs will regain their proper function, and the patient recover." As previously observed, Dr. Charteris has treated by this simple method two cases of diabetes in his wards in the Royal Infirmary, and both have been benefited.—*The Doctor.*

Mineral Substances in Drinking Water.—Professor Wanklyn read a paper before the British Association "On the Effects of the Mineral Substances in Drinking Water on the Health of the Community." He said,—Inasmuch as by the help of subsidence, reservoirs, and wholesale filtration, the water-supply of towns may be sufficiently cleansed from organic impurity, the selection of an appropriate water supply now resolves itself into the selection of water unobjectionable from a mineral point of view, and the question, what are the sanitary effects of the small quantities of mineral substances in drinking water meets the chymical adviser whenever he is called on to choose between different sources of supply. At present we are very much in the dark on these questions, and are obliged to fall back on the system of giving the preference to water, the mineral character of which is not in any way unusual, rejecting for town supply water of unusual mineral character. It is time, however, that better ground should be provided; and, with the object of placing the question on a firmer basis, I am endeavouring to get up a kind of register of the chief water supplies, and in course of time hope that peculiarities of bodily constitution may be connected with peculiarities of water supply.

At first sight, when first taking up the subject, both the chymist and the physician are inclined to protest against the notion that appreciable effects may follow from the slight mineral differences in waters. But a nearer view of the subject alters that frame of mind completely. The fluid taken daily by an adult man may be roughly set down at about half a gallon, and at that rate the mineral matter imbibed in a fortnight is quite appreciable. On the other hand, the amount of mineral matter in different articles of food is much smaller than might at first sight be imagined. In wheaten flour it is 0·6 per cent., of which the greater part is phosphate of potash. The mineral contents of the drinking water are not by any means overwhelmed by the mineral matter in ordinary dietaries.

One question which has often been asked is, whether it is better to drink hard water or soft water. The reply which has been given is, that at present we cannot tell, but that apparently the system can accommodate itself to either, and that a soft-water drinker is sometimes disordered when he begins to drink hard water. One of the characteristic difficulties met with in these inquiries is that, unlike our cows and horses, we are not confined to our water supply. In Glasgow, for instance, persons who drink beer receive the hard water of the breweries.

My object in bringing this question up is to call the attention of fashionable physicians to an excellent opportunity which has arisen, and which it would be a pity not to embrace, of studying the effects of hard water in a very exaggerated shape. I have found a water which contains about 100 grains of real carbonate of lime per gallon, and which is now being drunk in high society. The Taunus water, according to Mr. Taylor's analysis, contains, in one gallon: carbonate of lime, 97·3 grains; carbonate of magnesia, 12·3 grains; chloride of sodium, 180·0 grains; chloride of potassium, 17·5 grains; sulphate of soda, 4·5 grains. I have in the main verified that. Accordingly, Taunus water may be said to contain about 100 grains of carbonate of lime and 200 grains of common salt per gallon. At the present moment Taunus water, being largely advertised, is presumably largely drunk at Court and in aristocratic circles, and fashionable physicians have now an

opportunity of observing the effect of drinking a water five times as hard as the typical hard water of the country.

In the course of the discussion which followed, Dr. Carr observed, with respect to Kent water, which was very hard, that it contained a large per-centage of lime, and was very wholesome for young persons. The children of Kent were singularly straight-legged; and it was well known that lime readily assimilated in the system and created sound bone.

Professor Wanklyn said that Kent water was, as a rule, as pure organically as distilled water. Hard water was, it was true, good for children, as they required lime in various shapes; but it was very doubtful whether later in life hard water was so good for those who partook of it. In reply to Mr. Groom Napier, Professor Wanklyn said he had heard that hard water introduced goitre, but he could not say that was so without further inquiry.

The Effects of Coca Leaf.—At a recent meeting of the Edinburgh Botanical Society a paper was read by Sir Robert Christison on the restorative and curative effects of the coca leaf of Peru (*Erythroxylon coca*), which has for many years been valued by the Indians as a preventive of bodily fatigue, and which has lately attracted much attention owing to a belief that it was of some service to an American pedestrian, Mr. Weston, on the occasion of some walking feats at the Agricultural Hall. A diversity of opinion exists as to the effect of the coca leaf on those who chew it. By some travellers it is maintained to be a pernicious stimulant, while others hold the opinion that moderately used it is beneficial to health.

Of its effects Sir Robert Christison gave an account ascertained by experiments he had made himself with coca leaf, by which he had found that it was both a preventive of fatigue and a restorative of strength after severe bodily exertion, and that it had no reactionary effect on the system. His first experiments made with the leaf were in 1870. Two of his students had come home thoroughly tired out with a sixteen-miles' walk; instead of having dinner they each took an infusion of two drachms of coca; presently all signs of fatigue vanished, and they "promenaded" Princes-street, Edinburgh, for a whole hour with ease and enjoyment. On returning home they ate an excellent dinner, felt light throughout the whole evening, slept well, and got up refreshed and active next morning.

Similar results were obtained in the case of other ten students, some of whom had done a thirty-miles' walk; and Sir Robert has also made experiments upon himself with coca leaf, of an equally successful and comfortable nature. He is, it seems, overwhelmed by letters from all quarters asking for information respecting it. Women especially, having tried every other form of narcoctic and stimulant, are very anxious to begin with the coca leaf. One lady who has written to Sir Robert Christison on the subject, "put her question in such a shape that he saw plainly that she meant to ask whether it would renew her youth." In regard to its use as medicine, Sir Robert Christison recommends no one to try it till something more is known about it, or at least not to make use of it without consulting a physician.

It may not be uninteresting to know what the French say about this leaf. Professor Bouchardat states that the Erythroxylon coca had some years ago been introduced into France, and has rendered most valuable service in therapeutics, almost equal to that rendered by the cinchona bark. M. Bouchardat considers the coca as a stimulant to the

nervous and muscular systems, and ranks it as such with tea and coffee. He terms it also a "substance d'épargne," or that which prevents the rapid waste of tissue, and thus enables the consumer to go a long time without food. The leaves are either masticated or made into an infusion, and used like tea with rum and sugar, or with sugar and milk. The leaf contains an essential oil, which is of an aromatic odour coupled with the flavour of the fresh plant. The slightly acid and bitter taste of the leaf may be attributed to the presence of tannin, and to an alkaloid somewhat analogous to atropine, and is termed "cocaine." An infusion made with the leaves is perfectly clear, and of a beautiful yellow. It has an agreeable odour, and like the leaf itself is slightly acid and bitter. Many French people use the infusion as a substitute for tea, to which the coca is preferred owing to its being more stimulating, and at the same time less expensive. A "pharmacien," named Joseph Bain, was one of the first to introduce it into medicine in France, in the form of elixir and wine, which are frequently prescribed in prolonged convalescence and in cases accompanied with great prostration of strength.

The leaves of this plant, either smoked in a pipe or used as an inhalation, have a decided effect on bronchial spasm. Mr. L. Lewis recently employed it in this way with marked benefit in cases of idiopathic asthma, the dyspnœa and distress being much relieved, and more especially in chronic irritating cough. One gentleman, who could not sleep through paroxysms of coughing, now enjoys a full night's rest after smoking a pipe of coca mixed with a small quantity of tobacco. Moreover, it leaves no headache nor unpleasant after-effects.—*Homœopathic World.*

Blood-Vessels in Motion.—An apparatus of great delicacy has lately been devised by Dr. Mosso, of Turin, for measuring the movements of the blood-vessels in man. A description of it, with figures, appears in *Comptes Rendus* of January 24th. The arrangement of the *plethysmograph* (as it is called) consists in enclosing a part of the body, *e.g.*, the fore-arm, in a glass cylinder with caoutchouc ring, filling the cylinder with tepid water, and measuring, by a special apparatus, the quantity of water which flows out or in through a tube connected with the cylinder, as the arm expands or contracts. An opening in the cylinder is connected by a piece of caoutchouc tubing with a glass tube opening downwards into a test tube suspended from a double pulley with counterpoise, to which the recording lever is attached, in a vessel containing a mixture of alcohol and water. When the vessels of the arm dilate, water passes from the cylinder into the test tube, which is thereby immersed further, so that the counterpoise rises; in the opposite case water flows back from the test tube into the cylinder, the test tube rises, and the counterpoise descends. Among other applications of the apparatus, Dr. Mosso employs it in studying the physiology of thought and cerebral activity. The slightest emotions are revealed by the instrument by a change in the state of the blood-vessels. The entrance of a person during the experiment, in whom one is interested, has the effect of diminishing the volume of the fore-arm to fifteen cubic centimetres. The work of the brain during solution of an arithmetical or other problem, or the reading of a passage difficult to understand, is always accompanied by contraction of the vessels proportional to the effort of thought.—*Nature.*

The Medical Learning of Ancient Egypt.—Ebers, the German archæologist, has made an inte-

resting discovery of what is said to be a portion of one of the lost Hermetic books of medicine. Hitherto all attempts to trace the origin of the reputed Hermetic writings have failed, and it has been assumed that the great "Hermes" was a mythological personage invented by the earlier alchemists to credit the acquired knowledge with the authority of antiquity. The manuscript, when thoroughly deciphered, may throw some light on this doubtful point; but, even if it fails to do so, the fact that a fragment of the lost learning of the Egyptians has been recovered is a matter of scientific interest. The manuscript was discovered among the bones of a mummy some years ago by an Arab, and on his death it was offered to Dr. Ebers, who eventually purchased it at a considerable price. It consists of a single sheet of papyrus, about sixty feet in length, and the characters are in red and black ink. Judging from the characters, the date of the manuscript may be placed about 1500 B.C., making it 3000 years old: and, if written in the earlier part of the century, it would have been contemporaneous with the period of Moses's residence at the court of Pharaoh. Only a portion of the document has at present been translated by Ebers, including some of the headings of the various chapters, such as "The Secret Book of the Physicians," "The Science of the Beating of the Heart," "The Knowledge of the Heart as Taught by the Priest-Physician Nebsecht," "Medicines for Alleviating Accumulation of Urine and of the Abdomen." There is every reason to suppose that the Egyptians attained a far higher degree of scientific knowledge than many are inclined to give them credit for, at a very early period of their history.—*Lancet.*

The Future of Medical Men.—Terra del Fuego has been traversed by Lieut. Masters, R.N., who has discovered that the natives believe in devils, and hold them to be the departed spirits of members of the medical profession. The main object of their religious ceremonies is to keep these devils at a distance from them.

XVI.—BUILDING INDUSTRIES.

A New Material for Building.—A material suitable for blocks and bricks is, according to an invention of Messrs. Smith & Paterson, of Glasgow, made from two mixtures. The first contains coal-tar, mixed with small broken stones or shingle, a portion of which should be pulverised or mixed with sand, so that the interstices between the stones of larger size may be properly filled up. The second mixture is composed of clay and pitch; sand or chalk may be substituted for the clay. The first mixture is mixed in a mixing apparatus at a heat which is gradually increased until the product is adhesive to the touch. The second mixture is formed by grinding the powder thus obtained, and is added to the first mixture while its particles are adhesive to the touch. The mixture of the two compounds is confined in a close vessel, and heated so as to diffuse the vapours uniformly throughout the ingredients. In manufacturing a building block, the material, after being tested, is removed while hot to moulds, and pressed and shaped as required.

How Long will Zinc Roofing Last?—A controversy is just now going on in Germany as to the durability of zinc used for roofing purposes. The *Zeitschrift für Gewerbe* reproduces the calculations as to the durability of zinc made by Dr. Pettenkofer in Dingler's *Journal* some years since, but points out an error in them. Rectifying these afresh, on the basis that the oxidation of one square foot reaches 8·381 grammes in twenty-seven years, the *Zeitschrift* finds that a sheet of zinc half a millimetre thick would occupy 1243 years in complete oxidation. A weight of 8·381 grammes of zinc spread over the surface of a square foot would make a layer only the five-thousandth of a line thick. If the sheet be 0·25 line (a half of a millimetre) thick, there will be 46·04 such layers, and this multiplied by 27, gives 1243, the total number of years.

Water-Pipes of Cement.—Herr Fuhrenwald, in a communication to the Berliner Bezirks-Verein, states that the pipes first employed gave very unsatisfactory results, cracking readily with every change of temperature; but they have since been much improved. A sort of concrete is now used, out of which the pipes are moulded on an iron core, and hardened by slow firing for fourteen days. The shape is the same as that of ordinary earthenware pipes, but with raised external mouldings. Dyckerhoff & Sons, of Bierbich, on the Rhine, by whom these pipes were first introduced, make them without mouldings. They support a pressure of ten atmospheres. They are chiefly used for mains, and are free from the defect, common in earthenware pipes, of collecting impurities at the joints. The pipes are in lengths of 1·9 metre (about 6 ft.). Larger sizes are rather cheaper, and the smaller about the same price as earthenware pipes.

The Hardening of Cement.—There are, it is known, several varieties of material included under the generic name of Roman cement, which have the property of hardening, after a little, in air or under water. Portland cement is slower in hardening than the others. Inconveniences arise where the harden-

ing takes place too rapidly (as is the case sometimes where the material is used too soon after manufacture), the chemical changes which occur producing cracks, deformations, &c., which seriously compromise the structure. We learn from a report in the *Bulletin* of the French *Société d'Encouragement* that M. Ducorneau has discovered a simple means of analysis by which any builder may be able to ascertain—1, if a cement be Portland, or if it be one hardening more rapidly; 2, the age of the cement and the time of its manufacture; 3, its strength. M. Ducorneau also prepares a compound which, mixed with the cement in the proportion of one-tenth, has the effect of retarding the hardening process. It thus gives the cement the properties acquired by age, but without the loss of power of aggregation which too great age brings about. Details of the methods are not furnished in the *Bulletin.*—*English Mechanic.*

Rendering Wood Fire and Water-proof.—M. P. Folacci has devised a new mode of rendering wood waterproof and incombustible, which involves the use of the following composition:—Sulphate of zinc, 55 lb.; American potash, 22 lb.; alum (ammonia base), 44 lb.; oxide of manganese, 22 lb.; sulphuric acid at 60°, 22 lb.; river water, 55 lb. The above ingredients, with the exception of the sulphuric acid, are mixed in a boiler, where the water is added at a temperature of 113° Fahr. As soon as solution is effected, the acid is gradually poured in. To prepare the wood, the timbers are placed in a suitable chamber, on gratings, and separated by spaces of about a quarter of an inch. The composition is then pumped in to fill completely the receptacle, and is maintained therein in a state of ebullition for three hours. The wood is then withdrawn, and dried in the air. According to the inventor, it becomes practically petrified, and the most intense flame only carbonises the surface very slowly.

The Szerelmey Liquids.—These preparations, best known under the name of "liquids," are rapidly coming into more general use. They have been long known as really valuable articles for indurating stone-work, for waterproofing walls of all kinds, and for painting iron-work. The liquids are of three kinds: the well-known stone compositions as used at the Houses of Parliament; the iron paint in colours for iron-work of all kinds, which has already lasted seventeen years on the iron roofs of the Houses of Parliament; and the liquid enamel, a sort of paint, which dries rapidly, with a glossy and smooth surface. It can be used on wood, iron, and almost anything, including tar and pitch. To some extent it resembles the iron paint, but it is really a new series of preparations. Judging from the results obtained with the stone compositions and iron paints, the liquid enamels should find an extensive field of usefulness.

The Strength of Wood.—Herr Hirn has been conducting a series of experiments on the comparative strength of wood and cast-iron in their different applications, and finds that, in a great number of cases, the former has the advantage. The strength of the wood was found to be in direct ratio to its density; and this strength was increased by immersing the pieces of wood in linseed oil heated to between 80° and 100° Centigrade (185° and 212° Fahr.) for two or three days.

Damp-proof Bricks.—M. Sebille, a French architect, has obtained a patent for damp-proof bricks. He injects bricks, tiles, &c., with tarry products of coal distillation, and finds them perfectly impermeable to humidity. Nothing is said as to the kind of cement that is to be used with them.—*English Mechanic.*

Glass-roofing on a New Principle.—At the Great Western Railway the long railway shed extending from the Great Western Hotel to the departure platform has recently been almost entirely roofed with glass according to the new system invented by Mr. W. Edgcumb Rendle. The advantage gained lies in the fact that each pane of glass rests upon a groove, which is so constructed as to admit not only of the glass contracting or expanding with the variations of the temperature, but of the escape of all vaporisation from within; while at the same time no water from without can possibly penetrate.

A New Flooring.—A communication has been made to the North of France Industrial Society as to a new system of parquet flooring invented by M. Briffaut. The squares are composed of slips of oak or other wood, or a combination of woods, forming patterns; the pieces are held together by a layer of bituminous cement laid hot on their underside; and this cement is in turn covered with a paving tile, so that the three substances are intimately united. In order to obtain a more perfect adherence, conical iron pins are driven through holes left in the tiles, and into the wood, while the cement is still in a liquid state. The squares are laid in mortar or cement over a layer of sand, and are joined together by very fine iron tongues fitting in grooves. This system is applicable where marble and ordinary pavements are employed, and the inventor has the intention to apply it to cabinet-work.—*Journal of the Society of Arts.*

An Improved Floor Clamp.—Carpenters, cabinet-makers, and others, who find it frequently necessary to clamp flooring-boards or portions of furniture together, are provided, by an invention patented June 8, 1875, to Mr. W. D. Clark, of Springfield, Ill., with a novel and simple tool especially adapted to such purposes. It consists (says the *Builder*) of a sleeve, which at its lower extremity carries a cam, and at its upper end has a handle. Passing through the sleeve is a rod having a screw point at its lower end, and turned by the upper handle. Attached to a collar on the sleeve is a rearward extending arm, the end of which is turned downward and toothed, so as to engage with the surface of the joist. A slotted and grooved arm is pressed by the cam against the boards, when the said cam is suitably revolved by the handle. The holding arm prevents any rearward motion of the device, which is still further secured by the screw point entering the wood of the joist.

A New Method of Polishing Mouldings.—A machine for polishing mouldings was exhibited at the fair of the American Institute. It was an adjustable table, carrying horizontal rubber rollers, which grasp the strip of moulding and present it to the action of a reciprocating polisher. This last is a composition of fine emery, which is made in a plastic state and applied to a piece of moulding similar to that to be polished. The result, when the composition is hard, is a perfect matrix, into which every indentation or projection of the mould fits. The cast is then mounted in a box and rubbed to and fro on the moulding, as the latter is carried beneath it. The advantage gained is the increased sharpness and accuracy of the edges and the thorough polishing of the whole work—a proceeding of some difficulty by the ordinary use of sand-paper.

Innocent "Zinc-White."—In reference to a report by Mr. Redgrave, on the manufacture of white-lead, Dr. Barff, the Professor of Chemistry to the Royal Academy, again draws the attention of artists and the public to "zinc-white" as an innocuous substitute. The evils

of lead-poisoning extend not only to those who manufacture white-lead, but to house-painters, artists, and all who come in contact with it. Its defects as a pigment must lead to its being given up, sooner or later. The greatest of its defects, the tendency to turn yellow and lose opacity, arises from its saponifying when mixed with oil. Its principal recommendations are what is called its "body" (or covering power) and the ease with which it is laid on. Many artists are now using zinc-white, which retains its opacity and does not blacken on exposure to foul . For artistic purposes zinc-white can be prepared nearly equal in body to white-lead. For more than a year Dr. Barff has been working on zinc pigments with a view to their being used also in house painting; and from the results of his experiments he has arrived at the important conclusion that sulphide of zinc, properly prepared, can be made to have as good covering properties as white-lead, and that the addition of magnesia in the manufacture renders it as agreeable to work. Having arrived at this long-sought desideratum, the Professor "calls the attention of those interested to the fact that they can obtain a better paint in all respects than white-lead, and one which has no injurious effects on the health of those who prepare or use it."

Improved Dwellings.—In the beginning of June several members of the Royal Institute of British Architects paid a visit to the "improved middle-class dwellings," which Mr. Matthew Allen has erected on his estate at Manor Road, Stoke Newington. Mr. Allen, being convinced of the necessity of various improvements in suburban middle-class dwellings, after devoting several years' attention to the subject, carried out an experiment on a somewhat large scale in Manor and Bethune Roads, where he erected twenty-four houses, and the experiment was so far successful that the majority of them were let before they were completed.

The houses are divided into six blocks, and, while they are built on the "flat" principle, each house is entirely distinct. Of the twelve houses on the ground floor, eight let at £20 per annum, and contain five rooms, with lobby entrance, lavatory, coal cellar, larder, and other conveniences. Above these are eight £40 houses, containing nine rooms, occupying two floors, and fitted with bath-room—supplied with hot, cold, and soft water—lavatory, hot closet, conservatory, &c. There are four £35 houses, which have seven rooms on the ground floor, fitted with every convenience, and besides the garden in front, there is a large croquet lawn in the rear. Above these four houses are four £60 houses, each containing thirteen rooms, fitted with bath-room and other conveniences, and these have also a lawn in the rear. Beyond the croquet lawns is a long gravelled walk, having on one side flower borders, and on the other side lean-to greenhouses, vineries, &c. Behind the wall of the greenhouses are the gardener's cottage, potting sheds, coach-house and stables, and in a line with these is a row of washhouses—one for each tenant—fitted with washing coppers, troughs, &c. The roofs of the washhouses are flat, and form a long terrace walk. In the rear of the vineries and greenhouses is a kitchen garden, to which all the tenants have free access, and they can purchase any of its produce on application to the gardener, who calls at each house daily for orders.

The arrangements of the buildings, as regards the number of rooms on each floor, are partly upon the Scotch principle, while the laying-out of the grounds is after the French system; and Mr. Allen also claims that he has retained "the

all-important feature of an English home—perfect privacy." The ceilings between each flat are constructed of concrete, with iron joists running through the centre, and are therefore fireproof. In 1874, encouraged by the success of the above experiment, Mr. Allen began to erect two more blocks, comprising eight houses, on an adjoining estate, which were nearly all occupied as soon as they were completed; and last summer he erected two additional blocks, each consisting of six houses instead of four, and there are eight rooms in each house, which comprises one flat.

No wood is used in the construction of any of the carcases of any of the houses, and where iron is employed it is always embedded in concrete. There are no drains under any part of the buildings. All the internal partitions are constructed of brickwork, and in no part of the building is a lath used.

One of Mr. Allen's objects has been the saving of space generally wasted in passages and staircases, and in this, as in many other respects, he has decidedly wrought many valuable improvements.—*Times.*

The Patent Self-Acting House and Alarm Bell.—This is a very ingenious little instrument, constructed so that it may be applied to the inside of any door, when it not only prevents the ingress of a would-be intruder, but also gives a very loud and continuous alarm when any attempt is made at entry from without. It consists of a metal frame carrying a strong clock spring, which, when wound up and released, works a rack and pinion which are connected with a hammer, that is caused to vibrate rapidly and to strike the alarum; this it continues to do for a sufficient length of time to alarm the household. When in use it is placed on the floor, about three inches from the door to be secured, the upper point resting against the door itself. On the slightest attempt to open the door the point is pushed downwards and releases the catch that restrains the action of the alarum, which then rings loudly as long as the pressure is kept up against the door.

To ladies travelling and sleeping in hotels and lodging-houses this little contrivance will be a great boon; it gives a sense of security that is not afforded by any strange lock or bolt; and in some situations both are absent. It is really of no small importance that a traveller should retire to rest knowing that no attempt even can be made on her coin, jewels, or other valuables without creating an alarm sufficiently loud to wake not only herself, but the other inmates of the house.

The instrument is of a small size, being under 5 inches in length by 2½ inches in width; it is portable, comparatively inexpensive, and is contained entirely in one piece, no key being required to wind it. We can trace but one defect, which is, that if its presence is suspected it is possible to push it down from the outside by passing a long flat blade, as that of a table-knife, under the door. This, however, is a point that could be easily remedied by a slight alteration in the mode of manufacture. The price is moderate, and we should anticipate that it will be very generally used and appreciated.—*The Queen.*

"Made Ground."—A contemporary recently called attention to the peril of placing new residential property upon a foundation consisting of "old cabbages, fish-bones, old shoes," &c., to the depth of five feet. We fear the practice of "making ground" by levelling up with "rubbish" of every description is not only widespread, but almost universal. The custom, when a piece of land intended as

the site for an "improvement" requires raising, is to let it to some contractor, who immediately sub-lets it to a nondescript tradesman, who emblazons the site with a placard, "Brown's Shoot," "Robinson's Tilt," or "Rubbish may be shot here." If possible a hoarding is put up round the land; in any case a barrier of some kind is erected, and the speculator either himself takes a toll from the carts which congregate to the spot, or places an old man or woman to perform that pecuniary service on his behalf. This method of procedure is so commonly adopted that it is even pursued in the case of pleasure gardens. More than one square in a populous district of London has been recently "levelled up" with decomposing matters collected by the open "shoot." A year or two hence, when the land has settled, and the surface soil has been washed down, a putrefying surface will be exposed, and perhaps an outbreak of fever in the row of houses overlooking this elegant garden—so healthful for the children to play in—will perplex the local practitioners. It is absurd to go to the expense of closing intra-urban graveyards and removing nuisances by costly expenditure, if we create new beds of pest-breeding rubbish, and call them "made ground." The remedy officially proposed is to cover up the evil with a layer of concrete. This may be the only practicable plan where the mischief is done, but the practice should be summarily interdicted.—*Lancet.*

Are New Buildings Safe?—Regulations in regard to the fitness for occupancy of dwellings, especially new ones, demand a certain degree of dryness, and the questions as to what the amount of moisture in a wall at any particular time may be, and as to what state of dryness is required by considerations of health, have been much discussed. In particular places, a certain period for drying new buildings, dependent upon climate, material of construction, and style of architecture, may be fixed by experience as necessary, but the direct testing of the walls as to the amount of moisture in them has usually been untrustworthy. In view of these facts, a number of experiments have been made by Dr. Glässgen, under the direction of Professor Pettenkofer, for the accurate determination of the amount of moisture present in walls at any time, and a method has been found that gives satisfactory results. Portions of the plastering, taken from different parts of partition walls, were tested. The free water and water of hydration of the lime were determined separately, the former by drying sifted specimens in a Liebig's drying tube, in a current of air, freed from carbonic acid, and the latter by passing a current of carbonic acid over the specimen, thus dried, while heating it. The general conclusions from the tests made of a great number of buildings, under varying conditions, were that there is a constant loss of moisture proportional to the time, and that there is a great difference between the times of drying in winter and summer, and of exposed and unexposed buildings. Further tests, however, involving numerous details, are considered necessary, in order to answer the question as to when a new building may be declared dry; but it is hoped that the publication of the above method and the detailed results may lead to fuller investigation at the hands of competent persons.

XVII.—ILLUMINATION AND HEATING.

Notes on Gas-burning.—For artifical light, candles and lamps, when we can afford the cost of them, are better than gas. Gas is always burnt in excess, so that, unless there be very good ventilation, the foul air from it may be actually smelt, and together with the heat becomes oppressive. I believe no notion exists of the extent to which gas-burning is a source of damp. If we light an Argand burner, the glass chimney will in the first moment become clouded with moisture, the next moment the moisture will disappear, driven off by the heat of the glass. But this formation of watery vapour really goes on as long as the gas is burning, being caused by the combination of the hydrogen in the gas with the oxygen of common air. In many houses all the gas-burners are lighted at nightfall, and allowed to burn till bedtime; some being kept alight through the night. In a large house which structurally was dry, a client of mine complained of damp within the movable wardrobes, where the silk dresses had actually become wet. Suspecting the gas, I found they were burning as much of it as would generate over two gallons of water per day, much of which must settle on smooth surfaces in unwarmed, ill-ventilated parts of the house. A friend who went abroad during the cold of last winter, found the servants had aired his drawing-room by burning the gas night and day, till the walls were made thoroughly wet and the decorations spoilt. I once saw gas burnt for two or three weeks in order to dry some obstinately wet plaster, until the condensed water covered the ceiling and dropped plentifully upon the floor. Where much gas is burnt some effectual mode of carrying off the products of combustion is essential. Where the air in the room is not changed rapidly by means of a suitable fireplace, the ventilating globe light may be used as the best substitute, but it is difficult to apply it so as to ensure durability and continued perfect action. I may mention here that the Parisian Building Act does not permit the concealment of any part of a gas-pipe, any leakage can therefore be detected easily and at once repaired.—*Journal of the Society of Arts.*

Spontaneous Combustion.—The following are the conclusions at which the Royal Commission on the spontaneous combustion of coal have arrived:—"That certain descriptions of coal are intrinsically dangerous for shipment on long voyages. That the breakage of coal in its transport from the pit to the ship's hold, the shipment of pyritic coal in a wet condition, and especially ventilation through the body of coal cargoes, conduce to spontaneous combustion, even though the coal may not be unfit for conveyance on long voyages. That spontaneous combustion in coal cargoes would be less frequent if regard were had by shipowners and underwriters to these facts. That when coal is being carried on long voyages the temperature in various portions of the cargo should be tested periodically by a thermometer, and registered in the log. That with a view to guard against explosion, free and continuous egress to the open air, independent of the hatchway, should be provided for the explosive gases by

means of a system of surface ventilation which would be effective in all circumstances of weather. That, in order to make known the descriptions of coal liable to combustion, the inspectors of mines should be instructed to hold inquiry into all cases of spontaneous combustion occurring in cargoes of coal taken from their respective districts, exporters being required always to record on their specifications the denomination of the coal forming the cargo. That no additional legislation with reference to the conveyance of coal by sea is required, unless for the purpose of giving effect to our proposals with regard to the inquiries by inspectors of mines, and to the fuller specification of coal entered outward at her Majesty's Customs."

Paraffin.—Professor Odling, F.R.S., lectured at the Royal Institution recently on "Paraffins and their Alcohols." He first referred to the large group of hydrocarbons generally, pointing out that chemists are now acquainted with many hundreds of compounds of hydrogen and carbon, while still there are but two compounds known of hydrogen and oxygen, and two of carbon with oxygen. While most of them readily enter into combination to form further compounds, there is one easily recognizable group that does not, and the members of this group, from their slight affinity for combining, are called paraffins. The highest and most volatile varieties of the liquid paraffins constitute benzoline, a liquid of many uses in the arts, but exceedingly dangerous for lamps. Some cannon-like explosions were produced by igniting a little benzoline on cotton wool diffused in a jar of oxygen. The solid paraffins are largely used in the manufacture of candles. The paraffins are the most highly hydrogenised of the hydrocarbons, and hydrocarbons not belonging to the paraffin class become converted into paraffins by their direct or indirect fixation of additional hydrogen. The study of the proportions in which the relative amount of hydrogen and carbon occurs has been of inestimable value in affording a key to the solution of many difficult problems in organic chemistry. In all the paraffins—gaseous, liquid, or solid—it has been found that the number of their proportions of hydrogen exceeds by two proportions twice the number of their proportions of carbon. Professor Odling spoke of the isomerism of the paraffins as making known one of the most remarkable phenomena, and offering one of the most suggestive problems, of modern organic chemistry. The study of the conversion of paraffins into alcohols is of great interest, and, as far as is known, there appear to be as many isomeric primary alcohols as there are isomeric paraffins, and the study of these, more than perhaps anything else, helps to increase our knowledge of organic chemistry.

A New Use for Sewage.—Mr. Andrew Bray, of Manchester, has invented and patented an illuminating gas which seems likely to do much not only towards supplying a purer and cheaper light than that of the ordinary coal gas, but towards solving the great problems of how to economise coal, and how to dispose of our sewage. The source from which the gas is obtained is sewage water, one quart of which will yield forty-seven feet of the gas. Three retorts are fixed in a furnace, and when they are sufficiently heated, the liquid is passed through two of them, through an iron cylinder called the hydraulic main, which is elevated above the furnace, through the third retort, and then through a coil of metal piping immersed in cold water. Afterwards the processes resemble those employed in making coal gas.

It is claimed that the illuminating power of the new gas is treble that of the gas at present used in our streets, manufactories, and houses. For instance, a No. 1 burner consumes one foot of coal gas an hour, while a No. 3 consumes three feet; but when the new gas is used, a No. 1 burner will give as much light as a No. 3 through which coal gas is consumed. The new light is said to be clearer than ordinary gas, more like daylight in appearance, and more compatible with good health, because it is free from tar and sulphur, and cannot give off any waste carbon. As regards cost, we are informed that, while ordinary gas cannot be produced under any conditions for less than a shilling per thousand feet, the same quantity of the new gas may be manufactured, even in a small way, for less than a shilling. One of the reasons of this reduced cost is that only about twelve men would be required in making the new gas, against at least one hundred who are needed under the present system. We may illustrate this by explaining that in the manufacture of ordinary gas a good many men are necessary to keep up the supply of coal to the retorts, and to remove that which has been burnt into coke; but this work does not form part of the process of making the sewage gas.

Burning Gas from Wood and Petroleum.—The process of Messrs. Date and Eichbaum for making illuminating gas is sufficiently novel and interesting to warrant the following description of the system lately introduced into the town of Ingersoll, Ont. The retort benches (threes) here in use have some differences from the arrangement usual for coal-gas. The upper retort is provided with an inner or interior retort of cast-iron, into which a regulated supply of crude petroleum is fed by an air-compressing device. The operator having thus perfect control of the amount of oil introduced, a gas of any desired candle-power can be made. The charging of the retorts and the operations involved in the process are as follows: One of the lower retorts is charged with 150 pounds of ordinary cord-wood, and as soon as gas begins to be evolved—which is almost instantly—by means of suitably arranged pipes and valves, the wood-gas is thrown into the upper retort, in which it comes in contact with the heavy vapours evolved from the petroleum. The two gases thus commingled are then passed over a lengthened heated surface, the resultant product being a fixed or permanent gas of any desired illuminating power, leaving little or no residuum. The charcoal resulting from the process is declared to more than pay for the wood employed.

Petroleum deprived of Odour.—It has been very generally supposed that to attempt to deodorise petroleum was much like trying to wash a black man white, and certainly all the attempts hitherto made have ended in failure. It would seem, however, that Mr. S. E. Johnson, of Ashby-de-la-Zouch, and Mr. E. E. Johnson, of Manchester, have discovered a method of treating petroleum and other mineral oils, by which they not only purify but deodorise those useful hydrocarbon liquids, and, what is more, effect that desirable object in a simple and inexpensive manner. Chloride of lime is first introduced into the cask or other receptacle containing mineral oil or spirit, in the proportion of about 3 oz. of chloride of lime, more or less, to each gallon of the liquid, according to the degree of its impurity, and thus chlorine gas is evolved in the midst of the oil or spirit. If necessary the evolution of the chlorine gas may be assisted

by pouring in hydrochloric acid, when either by agitating the receptacle or by the application of an agitator or stirrer, the contents of such receptacle are agitated so as to bring the whole of the liquid into intimate contact with the chlorine gas; the oil or spirit is then passed into another inclosed vessel, containing slaked lime, which, having an affinity for the chlorine gas, soon absorbs the same, removing all objectionable traces of such gas, and leaving the mineral oil or spirit sufficiently deodorised and purified. —*English Mechanic.*

Gas-Burners in Competition.—There has been a discussion in Worcester (Mass.) as to the superiority of gas-burners. Professor Kimball says: "An Argand burner, consuming 5 ft. to 7 ft. of gas, gives 48 per cent. more light than the common brass fish-tail burner; the Ellis patent 48 per cent. more; the Evans 58 per cent. more; and the Garland patent 64 per cent. more. The Ellis equals the Argand; the Evans gives 10 per cent. more light, and the Garland 16 per cent. Two burners of each patent were used, and the results are given." The Garland patent includes in its specifications the tapering stop, outer case, and tip. There would seem to be no doubt, according to Professor Kimball's statement above, that by a perfectly fair test the Garland burner has distanced all competitors by 4 per cent.

An Improved Stove. — An improved stove has been invented by William Young Cruikshank, Shamokin, Pennsylvania. The object of this invention is to utilise the vastly accumulating anthracite coal-dust of coal mines in a direct manner, without special preparation and expense, so that the same is fed in a dried, heated, and well-regulated state to be burned in the stove or furnace. The new features consist in a distributing cone, a drying plate, and a revolving feeder, by which the coal-dust is conveyed in small and thin sheets continually to the fire below.

Petroleum as Fuel. — The average latent heat of the vapour of petroleum has not been very satisfactorily determined, but it is known to be very low. Dr. Ure states it at 184, that of steam being 1000, of alcohol vapour 457, and of ether vapour 313 — that is, an amount of heat that will vapourise but 1 lb. of water, and about 2·2 lb. of alcohol will vapourise 5·4 lb. of petroleum (assuming no important change of specific heat during the change of state). By measure the amount of heat or fuel that will vapourise 1 gallon of water should vapourise no less than $6\frac{1}{4}$ gallons of petroleum. This is an important practical point in this connection. The density of its vapour is very high, averaging, if the whole mass be converted into vapour, six and a-half times the density of air at the same temperature. At 500° Fah. it will pass into vaporous form, except a trifling per-centage.

Atmospheric Gas.—An invention of Mr. John R. Allen, of Chicago, relates to certain improvements in apparatus for carburetting air or gas for the purpose of illuminating and heating, its object being to thoroughly and uniformly charge the air or gas with the vapour of the hydrocarbon liquids—such, for example, as naphtha, benzine, and the like, in such a manner as to produce when burnt a brilliant and steady flame. The invention consists of an open-mouthed vessel, formed of two concentric cylinders united to a common bottom, and so arranged that an annular space is left between the two for containing water, in which annular space an ordinary gas-holder is set. The inner cylinder, which forms the carburetting chamber, is constructed with a flaring mouth, the object of

which is to prevent any hydrocarbon fluid from being carried over into the annular chamber between the two cylinders, and thus to avoid waste. Near the bottom of the inner chamber there is arranged a distributing box having discharge pipes, with an elbow or bend deflecting the air on the bottom of the carburetter in opposite directions, and making a thorough agitation of the hydrocarbon fluid.

A New Incandescent Light.—Hannecker, taking advantage of the properties of incandescence, has obtained a lamp of extraordinary brilliancy by directing the flame of a spirit-lamp of special construction, and fed by a current of oxygen, against a cylinder composed of silicate of lime, magnesia, and olivine, which latter is a natural silicate of magnesia. The cylinder composed of these earths is compressed by hydraulic pressure, in a manner not very different from the method employed for forming the cylinders used in the Drummond light.

Peculiarities of Flame.—The subject of flame is still involved in considerable obscurity. Among recent contributions to it may be noted one by Dr. Karl Neumann, in the August number of *Dingler's Polytechnisches Journal*. He accounts for the fact that a gas flame is not in immediate contact with the edge of the burner, or a candle-flame with the wick, as also that a flame does not come close to a cold body to which it may be applied, by the heat-removing action of the solid substance. The gases in certain parts are cooled down under their temperature of inflammation; and there the flame is extinguished. The great interval between the flame of a gas that is streaming out very quickly, and the mouth of the burner is mainly due, he thinks, to the velocity of the current in the neighbourhood of the burner being greater than the velocity of propagation of the inflammation. At the point where the flame begins, in such a case, the latter velocity becomes equal to the former. The comparative velocity of inflammation of different kinds of gas or vapour burning in air might thus be experimentally determined.—*English Mechanic.*

An Improvement in Safety Lamps. — An improvement in safety lamps has been devised by M. A. B. Boullenot of Paris. It consists in supplying safety-lamps with air from outside the mine. Fixed pipes are carried down the mine, and branches are led into all the workings. Through these, compressed air is forced from the surface by air-pumps, and lamps are screwed to the air-pipes. The cylinder which incloses the flame is protected by a cage, and the products of combustion pass off through two pieces of wire gauze. The match for lighting the lamp is inserted through a spring clip, ignited within the lamp, and cannot be withdrawn until extinguished.

Sulphur in Gas.—An endeavour has been made recently to prove that the sulphur in gas cannot be sensibly injurious, since the sulphurous acid in a gas-lighted room is said not to amount to more than one-half-millionth part of the atmosphere filling the room. But just as in the parallel instance of drinking-water, the difference between a pure and an impure atmosphere resides in these minute differences, and one part of sulphuretted hydrogen in two millions of air would render the air intolerably vile. A proper estimate of the importance of tracing powerful poisons in the air we breathe is encouraged by considering how great is the quantity of air which we take into the lungs and bring into contact with the delicate lung-structure in the course of the twenty-four hours. And there can

be little doubt that anything like one part of sulphuretted hydrogen or sulphurous acid in two millions of air, would constitute a most serious atmospheric impurity.—*Sanitary Record.*

The Dangers of Petroleum.—The catastrophe consequent upon an ordinary accident in the use of petroleum for the purposes of artificial light on board the *Goliath* training-ship naturally suggests serious misgivings as to the employment of that treacherous material. The vessel was under the management of local poor-law officials, and the first question that arises is, is it the practice for those officers, when in charge of workhouses, infirmaries, or pauper schools, to adopt the same means of illumination? The horrors of a workhouse filled with the old, the sick, the imbecile, and very young children, such as constitute the usual residents of such an establishment, set on fire by a similar and by no means uncommon accident to a similar agent, are terrible to contemplate. The cheapness and illuminating power of mineral oil are a great temptation to its use. Improvements in lamps for burning it are carrying it into use far beyond the dwellings and the shops of the poor. To disguise its real nature, a variety of fine names are given to the product of the oil wells refined up to different degrees of purity. The primary danger of the unrefined or imperfectly refined sorts of oil—that of giving off a highly inflammable gas at a low temperature—can be avoided by the manufacturer; but nothing, we believe, has been done, or possibly can be done, to prevent rock oil, under any of its aliases, when spilled in contact with flame, causing an inextinguishable fire so long as a particle of it remains unburned. A barrel of gunpowder is not a more dangerous piece of furniture in a room than a petroleum lamp, under whatever designation it obtained its entrance.—*Pall Mall Gazette.*

Stoves and Grates in New Rooms.—It has been suggested, remarks the *Sanitary Record*, by Mr. Eiloart, who had for some years the management of the buildings erected by the Society for Improving the Dwellings of the Industrious Classes, that stoves and grates should in future be dispensed with in the rooms of any new establishments for working-men, built under the Artisans' Dwellings Act. He has found that the chief difficulty of the inmates has been in the storing of the coal and other fuel in their rooms, and that, when to this was added the subsequent disposal of the ashes, the nuisance became a grievance. He recommends that the buildings should be warmed throughout upon some principle which will, whilst heating the rooms, furnish at the same time a constant supply of hot water to the tenants. The suggestion is an excellent one, and, fortunately, there is a system of heating extant which is equal to both services. With the common method of heating by hot water, of course, it is not possible to withdraw any of the circulating water, nor would it be pure if it were withdrawn. But with the cylinder system the water can be withdrawn at any time from the pipes, and the circulating water can be as pure as possible. The cylinder is always kept full, and as the water heats, it courses along through the heating coils, which, however, can be fitted up with stop-cocks should the heating not be necessary. There is no possibility of any explosion of the boiler, for the boiler holds but a few quarts of water, and the cylinder cannot possibly suffer from the effects of frost. The only fire that would need attention would be one in the basement floor, and that could be fitted up with the slow

combustion furnace. We understand that Mr. Eassie has adopted this method of hot-water supply, and has found it to answer admirably. With it a house can be heated with hot water, and the same water can be drawn off at any level for culinary or ablutionary use.

The Gas Supply of London.—Mr. H. Chubb (late Secretary to the Imperial Gas Company) read a paper on "The Supply of Gas to the Metropolis," before the Statistical Society. London was now supplied, said Mr. Chubb, by eight companies, but there were originally thirteen. These eight companies had seventeen manufactories; the share and loan capital of the united companies amounted to rather more than 11,000,000*l.* sterling, and the maximum rate of dividend allowed to be paid on the total share capital averaged 8·7 per cent. In the aggregate over a million and a half tons of coal are used every year in the manufacture of gas in the metropolis, and the quantity consumed in the past year amounted to about thirteen millions of thousands of cubic feet. There were at present 54,119 lamps in the public streets in the metropolis, lighted by means of gas; and the mains of all the companies, of various sizes, from 4 ft. to 3 in. in diameter, reached the enormous length of over 2,000 miles. This immense trade had risen up within the last sixty years. After alluding to the recent legislation with regard to the metropolitan gas companies, he referred to the various charges brought against them. The alleged overbearing conduct of the companies was probably due in some measure to the necessity which existed for the companies to ask their consumers to pay their accounts with some degree of punctuality; but the London companies collected their accounts, not monthly, as was done in many provincial towns and in all continental cities, but quarterly; and as to the alleged high price, in no city of the world outside England was the supply of gas so good or so cheap. In London the normal price was at the rate of 3*s.* 9*d.* per 1000 cubic feet for gas equal to sixteen sperm candles in illuminating power. In Paris the price was 6*s.* 7¾*d.*; in Berlin, 4*s.* 3⅓*d.*; in Amsterdam, 5*s.*; in Vienna, 5*s.* 8½*d.*; in New York, 10*s.*; and in the other cities in the United States 12*s.* per 1000 ft., and the quality in these places was much inferior.

XVIII.—ENGINEERING.

Boring Artesian Wells.—In various parts of Scandinavia, Artesian wells are bored by means of a jet of water. A description of the process is given in *Dingler's Polytechnisches Journal.* The stones, in the diluvial ground, which are a hindrance to such operations, are thrust to the one side if small; if large, they are shattered with dynamite, and the boring is thereafter proceeded with. In Kiel twenty-two Artesian wells were thus bored in the last half of 1875.

Under the Water to France.—One of the most remarkable and at the same time impracticable plans which have been suggested for rapid and agreeable transit across the English Channel, has recently been exhibited at the Palais de l'Industrie in Paris, by its inventor, Dr. La Combe. He calls his project "the submarine boat," but the boat is really a portion of a huge carriage which is to run upon a railroad laid on the sea bottom. There is no tunnel, nor anything thereunto resembling. The road bed is of *béton,* which is laid by divers, and on this are fastened three galvanised iron rails. The outer ones are for the wheels of the carriage, and the inner one is raised so as to be embraced by rollers, centrally attached to the latter in order to prevent rolling and derailment. The boat, at all points watertight, is secured to the heavy carriage, and the whole is driven by a screw actuated by compressed air transported in suitable reservoirs. The latter also supply fresh atmosphere for respiration within the boat, and a machine is provided for removing any excess, as well as the vitiated air. The interior is illuminated by the electric light, the current being led to the vessel by a wire from Dover; said wire also serves for telegraphic purposes. The inventor proposes to arrange guard rails so as to keep the track always clear, and he provides a double-doored chamber in the vessel, so that, in case of necessity, a diver can emerge to examine the line. Should by any possibility the vessel stop, a buoy is immediately sent to the surface of the water, carrying an air tube, so that the supply of air may not fall short; and in case of grave accident, the vessel can be altogether cut loose from the carriage, when it will rise to the surface and float. A series of buoys on the surface will mark the line of the road. Dr. La Combe thinks that his project is practicable, and believes that his vessel could make the journey of 21 miles in about half-an-hour.

Wasted Water-power.—At a meeting of the Edinburgh and Leith Engineers' Society, in the early part of 1876, a paper on the "Utilisation of Water-Power" was read by Mr. R. C. Reid, who, after expressing the opinion that the price of coal must inevitably increase, described the Shaws Waterworks for supplying water to the manufacturers of Greenock, and the amount of work they were capable of yielding, estimated to 1,000 horse-power. Mr. Reid next referred to the immense sources of unused mechanical energy in our rivers, and to the admirable means of storing water, which at present existed in the various lochs. He estimated the energy of the water flowing out of Loch Tay at 12,000 horse-power, Loch Rannoch

at 23,600, and of Loch Awe at 8,000 horse-power. The tides were also a source from which could be derived a great amount of power, and Loch Etive, at Connel Ferry, was pointed out as a most favourable place for utilising tidal energy. It was estimated that the tides in the locality were capable of exerting 10,000 horse-power.

The Liverpool Landing-stage.—It will be remembered that on the afternoon of the 28th of July, 1873, the great landing-stage at Liverpool was destroyed by fire, an occurrence which caused no little inconvenience to the passengers crossing the Mersey. The old stage consisted of iron pontoons, which supported five large wrought-iron kelsons on box girders, about 20 feet apart, running longitudinally the whole length of the stage. Across these kelsons were placed pine beams the width of the stage, and varying in thickness from 16 inches to 14 inches by 12 inches. Upon these beams was fastened the longitudinal pine deck, or planking, 6 inches by 4 inches, and crossing this again were greenheart sheathing planks, 6 inches by 2 inches. The whole of this was caulked and pitched, to make it independent of the action of the water and the weather. The new stage consists of the pontoons and large wrought-iron girders as before, but, in place of wooden beams, iron beams have been substituted through the entire length of the stage. The pine deck-planking has been replaced with greenheart, and greenheart sheathing, as before, completes the decks. The new wrought-iron beams weigh nearly 1500 tons, and this fact alone will give some idea of the magnitude of the undertaking, which has been successfully completed by Messrs. Brassey, who were the contractors for the works.—*Quarterly Journal of Science.*

The new Market-place of Madrid.—A new market-place has been opened at Madrid, the materials of which were all sent out from this country. In design these markets are somewhat similar to the Halles Centrales in Paris, but are bolder, more ornamental in character, and very lofty. Structurally, the markets are composed of separate pavilions, the Mostenses market having three, each 127 feet long and 90 feet wide, the pavilions being connected by passages, making altogether a rectangular area of 38,500 square feet. The Pebada market covers an irregularly-shaped area of 60,000 square feet, and is composed of four principal pavilions, each 119 feet long and 79 feet wide, three irregular pavilions and one lofty central dome, the pavilions being connected by several ways, as at Mostenses. In these two structures there is nearly 4000 tons of cast and wrought-iron. Below each market the space is utilised for cellars, the ground-floor being supported by cast-iron stanchions. The roofs are covered with galvanised corrugated iron, and there is ample ventilation by open louvres in the roofs and sides of each pavilion.—*Quarterly Journal of Science.*

Paving with Pig-iron.—Twenty different kinds of paving have been tried in Paris; wood paving has been judged, in bitumen paving there is room for improvement, and paving by pig-iron has at last been tried. A bed of mortar is first laid down, which is covered by a strong layer of asphalte; it is in this layer that the iron cakes, which are about 1·6 in. thick, are set. These cakes, it appears, preserve the homogeneity of the bitumen, and prevent its depression, and render the asphalte less slippery for horses. This pavement will cost more, assuredly, than the compressed asphalte, but it is estimated that this mode of paving will save 50 per cent. upon the repairing ex-

penses, which are very considerable. The end desired is to avoid, by the adoption of this kind of pavement, the depressions in roads over which a great deal of traffic passes. To attain this, it does not suffice to pour bitumen upon a well-prepared ground lightly covered with a coat of lime: the resistance of the ground should equal that of an old macadamised bank; and a thick bed of mortar, which should be very homogeneous, should be laid before the asphalte.

The Battle of the Pavements.—After a sufficient comparative trial, the contest between granite, asphalte, and wood for carriage-ways has been decided in favour of the last, and a recent conclusion of the Corporation of London may be regarded as a final confirmation of that decision. Mr. Heywood, engineer for the City, has shown that before a horse falls he may be expected to travel on granite 132 miles, on asphalte 191 miles, and on wood 446 miles; and although between the last two materials there is a trifling advantage in cost on the side of asphalte, that is much more than counterbalanced in other ways. In easy traction and the absence of noise there is no comparison between wood and granite, and since the surface water has been kept out by means of asphalte, wood has become one of the most durable of pavements. The rapidity with which it can be laid and the ease with which it can be repaired are not the least of its merits, while the flooring of planks, which is now laid as a substructure, gives great elasticity, and by distributing the weight equally over the whole pavement adds to its power of endurance.—*Iron.*

On the Pneumatic Transmission of Telegrams.—A paper on this subject was read before the Institute of Civil Engineers on the 16th November, by Mr. R. S. Culley and Mr. R. Sabine. The paper commenced with a short sketch of the history of the process, and gave a statement of the extent to which it had now attained. There were twenty-four pneumatic tubes in London, of an aggregate length of 17 miles 1,160 yards—four tubes in Liverpool, three in Dublin, five in Manchester, three in Birmingham, and one in Glasgow. The London system was described. When the number of tubes became large, it was found necessary to simplify the valves and sluices, rendering them less automatic, but easier to keep in order than the earlier apparatus. Lead was preferred to iron as the material for the tubes. An experience of twenty-one years had shown that with felt message-holders, or carriers, there was no abrasion of the metal, which became highly polished and that the tubes were practically air-tight, the exhaustion in one, 1,289 yards in length, occupying thirteen minutes in falling from 17·25 in. of mercury to atmospheric pressure, including the leakage from the valves. Iron had been used for two tubes, each 2,610 yards long, but it was found to rust rapidly, and to wear out the carriers. In the Paris system the iron tubes did not rust, and it was suggested that the difference was due to the air in Paris being carefully cooled by water, and to the friction of the heavy carriers of iron covered with leather; while the air in London was used warm from the pumps, and the carriers were made as light as possible. The diameter adopted for the tubes was 2¼ in., as being large enough to carry the traffic with sufficient speed, and not so large as to require a costly volume of air. The process of laying and jointing the tubes was explained. The carriers were cylindrical boxes of gutta-percha, covered with shrunk drugget; their weight was 2¾ ounces. The traffic was regulated by electric

signals. Stoppages were rare, and were cleared by filling the tubes with water and applying pressure. It had never been necessary to open a lead tube, except in cases of bad construction or of external injury caused by workmen. The engines were on the Wolff principle, and in ordinary work expended 134 h.p. The pumps were so arranged that each could be set to compress or to exhaust at pleasure, and the air-valves were fixed in sliding pieces, so that a defective valve could be quickly replaced.

Gigantic Tunnelling Works.—A comparison of the works in the Saint Gothard with those in Mont Cenis affords a means of estimating the progress that has been realised in the tunnelling art. It appears that while the metre of the Mont Cenis tunnel cost 4,500f., that in the St. Gothard costs (hitherto), at the maximum, 3,200f. in the walled parts. Further, the average rate of progress in Mont Cenis was 1 kilometre in the year; in the St. Gothard it is, thus far, 1·86 kilometres. An interesting account of the St. Gothard undertaking is given in the *Bulletin de la Société d'Encouragement* for November. The real commencement of the work may be dated 16th November, 1872, at Göschenen, and 13th September, 1872, at Airolo; and it appears that in the harder rock, the granite of Göschenen, a more rapid advance has been made than from Airolo, owing to homogeneity of the rock and the absence of water. At Airolo the flow of water is about 200 litres per second, and the hardness and stratification of the mica schist there constantly varying, it is necessary to alter the number, arrangement, and depth of the bores for each attack. The mean daily advance for the whole of the tunnel has been 3·930m. in 1873, and 4·900m. in 1874. More holes are bored in the granite for each attack, but the depth of the holes is greater in the mica schist. The total duration of one attack, with all its preparations, is about eight hours; in exceptional cases it has risen to 13 and 17 hours. The number of holes bored in advancing one metre varies from 12 to 38. The number of perforators used up in advancing one metre is from 2 to 3. —*English Mechanic.*

The Suez Canal.—In two recent notes to the French Academy M. de Lesseps speaks of the Suez Canal and the bitter lakes in the Isthmus. There is a bank of salt in the middle of one of these lakes; and, it appears, curiously, that, notwithstanding the dissolution of this bank and the evaporation, the saltness of the water diminishes. The probable explanation is that, owing to difference of density between the water of the lakes and that of the extremities of the canal, currents are formed of the heavy water below to the sea, while surface-currents bring water from the sea less charged with salt, to compensate the loss by evaporation. The dredging machine outside the jetty west of Port Saïd has worked efficiently during 1874 and 1875, removing the deposits to a distance of 800 metres. Vegetation is beginning to appear in the desert along the canal. Voyagers and the inhabitants of Suez complain much less of summer heat than formerly.

Future Engineering Triumphs.—If another stupendous engineering feat on the *tapis* be successfully accomplished, another slice of Holland will have been taken, or, to speak by the book, retaken by the Dutch, at the cost, however, of destroying a popular measure of a convivial Dutchman's capacity, whose draught everybody knows "should be deep as the rolling Zuyder Zee." It is now proposed to drain this immense island gulf, in extent 200 and odd miles by about 60, once indeed, what it will probably again

be, a fruitful plain dotted with smiling villages. The Haarlem Lake, the bed of which was overwhelmed by an eruption of the sea in the sixteenth century, was drained not many years ago by a company of English engineers. The Zuyder Zee dates from about the time when Earl Godwin's lands became a treacherous sandbank, an epoch remarkable for extensive inroads of the sea along the whole southern coast of the German Ocean. A writer in the *Daily News* observes that the addition which the drainage of the Zuyder Zee will make to Holland will be equal to the superficies of the county of Surrey, or nearly 6 per cent. of the whole present area of that country. If successfully completed, perhaps the feat may stimulate to a similar attempt to roll back the waves from a tract fully as large on our own eastern coast, which is believed by engineers to be quite as practicable. This is the age of immense engineering enterprises; and with telegraph communication literally extending "from China to Peru," the Mediterranean and the Indian Ocean connected by an artificial water-way, and England and France in a fair way of being united by a tunnel, the project of turning Cottonopolis into a seaport cannot seem such a great matter as it would have appeared a generation ago. Indeed, just a century has elapsed since the people of Glasgow, cautiously and tentatively, as is the wont of their countrymen, commenced a similar undertaking, which has become a great success, large ships now coming up into that city and discharging at a wharfage which extends upwards of three miles, the harbour dues bringing in a clear income to the corporation of at least £150,000 a year, after providing for dredging and all other expenses. The promoters of the Manchester scheme propose to strengthen, deepen, and widen the river Irwell from below the town downwards to its junction with the Mersey, and to apply the same process to the latter river thence to below Liverpool. Thus a tidal channel will be provided from the vicinity of Manchester to the sea, 33 miles in length, 200 feet in width, and with a *minimum* depth of 22 feet. The ships will be brought up by means of tugs in the same way as they are hauled through the Suez Canal. The increased capacity of the channel will carry off floods as well as greatly increase the flow of tidal water, and not only augment the scouring action of the river higher up, but also act beneficially on the bar at its mouth. The total cost of the undertaking is estimated at three millions and a half sterling, not too large a sum for the advantages that may be expected to accrue to the town and trade; while, if we may judge from the case of Glasgow, it would offer a highly-profitable investment for those who may supply the capital—an important consideration in these days.—*Iron.*

XIX.—MINES AND MINERALS.

The Minerals of Europe.—The Austrian statistician, Brachelli, reckons the total production of minerals in all the countries of Europe for 1874 to have been as follows:—Platinum, 1,025 kilogs.; gold, 6,900 kilogs.; silver, 300,000 kilogs.; pig iron, 240,000,000 cwt.; copper, 600,000 cwt.; lead, 5,300,000 cwt.; zinc, 3,000,000 cwt.; coal, 4,376,000,000 cwt.; salt, 95,000,000 to 100,000,000 cwt.; manganese, 1,616,000 cwt.; antimony, 5,700 cwt.—*Journal of the Society of Arts.*

Fire-damp.—A recent accident in the Jabin pit at St. Etienne, in the department of the Loire, gave rise to an interesting discussion at a recent sitting of the Académie des Sciences, as to the means now available for averting similar catastrophes. M. Azema proposed to replace ordinary safety-lamps by electrical lamps, completely closed, and which should be extinguished on any attempt being made to open them. M. Faye, on the contrary, advocated the placing of naked lights at every ten metres, which, in his opinion, would cause the danger to disappear as it arose. M. Berthelot, having made several experiments on this subject by means of mixtures of gas and air in defined proportions, opposed this method, as he had always found that an explosion occurred suddenly at the moment the gas attained a certain proportion. He had, however, observed that when the mixture was not a very intimate one—as was the case in collieries—a partial ignition only took place, which was confined to those portions of the mixture in which the gas had attained its dangerous proportion, and this without causing an explosion of the neighbouring portions which contained a smaller per-centage of gas. But the conditions under which this phenomenon occurred were so critical that it would be useless in getting rid of the gas in a colliery; besides, these explosions, partial though they were, did not occur without danger, for they always rendered the atmosphere irrespirable. M. Boussingault attributed the explosion to an excessive ventilation.

Gold in Victoria.—The yield of gold in Victoria appears to be gradually falling off. In 1871 it amounted to 1,290,844 oz.; in 1872, to 1,218,094 oz.; in 1873, to 1,162,492 oz.; and 1874, to 1,105,115 oz. The number of persons engaged in Victorian gold mining last year was 46,012, or 5,545 less than in 1873. (*See also* Miscellaneous.)

Ludwigite, a New Mineral.—Tschermak describes the mineral, named in honour of Ernst Ludwig, as finely fibrous, with the fibres in general parallel, and consequently of a silky lustre, in fresh pieces. The colour of one modification is dark green, whilst that of the second appears almost black, with a trace of violet. It is very tough; the fibres are separated with great difficulty. In some cases the length of the fibres reaches three inches, but as a rule they are shorter, and change their direction at short intervals. Its hardness is about 5; specific gravity, 3·907 to 3·951; of the dark variety, 4·016; streak, dark green. On heating in the air it turns red. According to analysis the main constituents may be assumed to be a borate of magnesia, of the formula $2MgO, B_2O_3$, and an iron compound, $2FeO, Fe_2O_3$.

Searching for Coal at Barrow.—Boring at Barrow-in-Furness, in search of coal, was carried on for a considerable time in 1876. It was, however, at last discontinued, a depth of 2,200 feet having been reached with no prospects of coal measures, such as would pay for working, being arrived at within an easy depth.

Digging for Gold.—The *Melbourne Argus* says:—The most important discovery ever made in connection with gold mining in this colony, with the exception of the original discovery of gold in 1851, occurred here on the 11th of September last. It is the finding in the shaft of the Magdala Company at Pleasant Creek—or, as it is now called, Stawell—of a gold-bearing quartz reef at the unprecedented depth of 1,681 feet, or about 700 feet further into the interior of the earth than gold has ever yet been obtained in Victoria.

Coal for Eight Centuries.—M. Grunner has been drawing attention to the probable exhaustion of the English coal mines. He estimates the maximum production of our collieries for all time at 250,000,000 tons. It is at present 130,000,000 tons, and he assumes, from his examination, that our coal will not be exhausted in less than eight centuries.

A New Mineral.—At the meeting of the British Association, Prof. Von Lasaulx, of Breslau, exhibited specimens of a new mineral which he described, from its behaviour before the blow-pipe, under the name of Melanophlogite. It crystallised in small cubes, which were seated on crystals of sulphur and celestine from Girgenti in Sicily. The mineral contained 86 per cent. of silica, 3 per cent. of water, small quantities of iron and strontium, with 7 per cent. of sulphuric acid or some acid of the thionic series not yet determined. The Professor also describes certain garnets which exhibited the phenomena of double refraction. Prof. F. W. Rudler made some remarks on the value of this communication, and on the extraordinary chemical constitution of melanophlogite. He also referred to various anomalies among monometric minerals, such as boracite, senarmentite, and alum, and gave an explanation of the means by which such anomalies had been explained. Reference was also made to Biot's theory of lamellar polarisation, to the effect of tension, and to those of decomposition, as explaining the anisotropic characters of those crystals.

How to Manage Fiery Mines.—In the management of a fiery mine; 1. There ought not to be any unventilated wastes. 2. The mixed use of Davy lamps and naked lights should not be permitted where the former are commonly employed. 3. Blasting of coal by gunpowder should not be sanctioned where Davy lamps are in common use. 4. An anemometer under the care of a competent man should be in constant use, in order to see that a sufficient current of air is passing through the workings to insure perfect ventilation of the mine. 5. When there are marked indications of fire-damp in a mine, shown by a cap on the flame of a lamp, the men engaged in hewing and drawing coal should be removed from the pit until by ventilation the place is cleared of gas and rendered safe for a working collier. The above precautions may probably cause an increased cost in the getting of coal, but they are necessary for the preservation of human life if such catastrophes as now frequently occur are to be prevented.

XX.—MACHINES AND MACHINERY.

A Steam Navvy.—An American steam excavator has been doing navvy's work in a cutting near Glasgow. It consists of a crane carried on a carriage with four wheels, and holding suspended from its jib a strong and large iron bucket. Four teeth or claws attached to the machine are brought to the face of the cutting, and tear the earth into the bucket. Three men are required to work the "navvy," a driver, fireman, and a crane man. Four or five men are required to shift the waggons from the drop, and with their assistance the excavator does as much work as sixty hands.

Belts for Mill-machinery.—Driving by belts, instead of by gearing, is now becoming general in mills. In a cotton-mill at Bolton, a fly-wheel belt has been employed, made on Sampson's system, 38 in. broad and 90 ft. long. It will transmit 350-horse power. This is the largest belt ever made in England.

An Improved Clock-work Governor.—In order to secure perfectly regular motion in the clock-work applied to revolving lights in lighthouses, Dr. Hopkinson, the scientific adviser of the glass-works of Messrs. Chance & Co., near Birmingham, states that he has introduced a simple centrifugal governor. The governor balls have to lift a heavy weight, which is in the form of a fly-wheel, and the circumference of which, on being raised slightly, presses against certain fixed pads, the friction of which soon diminishes the velocity of rotation of the fly-wheel and the governors sufficiently to allow the latter to fall back to their original position. He calculates that work to the extent of 500 pounds per minute must be done on the governor in order to accelerate the clock one second per hour. This form of governor possesses the advantage that it checks any acceleration of the clock more promptly than when friction rubbers are carried by the governor balls; and it is also easy to adjust.

Machinery in Corn Fields.—Traction engines are now being used for all the purposes for which portable engines have heretofore been used, and for several others besides, one of which is reaping. A reaping-machine of the Bell type is supported by suitable angle-irons in advance of the engine, and is driven by a pitch-chain. A crane is attached to the engine, which lifts the reaping-machine off the ground when not required to be at work; and, the machine being lowered down before the engine, a strip of corn of about 11 ft. in breadth is cut at the rate of three miles an hour. At the end of the field the machine is lifted off the ground till the traction-engine gets itself into position for another cut; and so the operation proceeds, the machine supplying the cutting apparatus, and the traction-engine the motive power.

Improved Shuttles for Sewing Machines.—Mr. William Reid, shirt manufacturer, Ropework-lane, Glasgow, has made a series of experiments with mechanism for economising thread in machine sewing, which have produced some remarkable results. The principle aimed at by Mr. Reid was the simplification of the methods of using the thread; and instead of winding it on bobbins or spools, as hitherto commonly practised, he resolved to

dispense with these entirely by winding and using the thread in the form of cops. For the purpose of using these cops in sewing machines, the patentee has constructed a shuttle with a spring tension preferably placed on its cover, and the thread passing round or under this spring effectually removes any kinks which may have run out in the process of unwinding. Mr. Reid has also invented a method of using cops for the upper qualities of thread, which admits of continuous lengths of 2,500 yards, or more if desired.

The Prevention of Shafting Accidents. — Many suggestions have from time to time appeared upon the subject of preventing or lessening the liability to accidents arising from the entanglement of some portion of an operative's garments in a swiftly-revolving shaft, which accidents are of too frequent occurrence in large manufactories, and are of a distressing or fatal character. One of the simplest methods of rendering these casualties impossible, without introducing the necessity of constructing a railing or fender about the moving piece in dangerous places, is to cover the shaft with a loose sleeve along its entire length. This may be made of sheet tin or zinc, and should be removable if desired. It should be covered within, and at the ends, with leather, to prevent noise. Arranged in this manner, the friction between it and the revolving shaft would be sufficient to cause the sleeve to rotate with the latter; but in the event of any decided resistance being brought to bear upon it, as in the case of the entanglement of a workman's garment, the sleeve would at once be brought to rest and permit of its extrication without accident. The same idea of loose covers may be applied to cog-wheels or pulleys, and prove an invaluable protection against loss of life or injury to the person.

Rotary Engines. — According to the invention of M. Urbain Chauveau, of Paris, a cylinder is arranged with a piston which may be actuated by steam, compressed air, or gas, so as to move round an axis passing through a centre. If a point of the piston-rod is forced to move in the space of a fixed circle having for its centre a given point, so that the distance is equal to one-half of the stroke of the piston, it will be readily understood that the alternate motion of the piston in the cylinder will produce a continuous rotary motion of the said cylinder round the axis. Different arrangements of mechanical parts may be employed to carry out the principle above mentioned, and the construction of rotary engines of this character may be varied to a great extent, and yet in accordance with the same principle. The admission of steam may be made in any ordinary manner.

Steam Men and Mechanical Horses. — Among the curiosities which the Centennial Exhibition at Philadelphia has produced are a mechanical horse and some steam men. These automata are said to be simple in construction and very satisfactory in their movements.

The Type Writer.—At a recent meeting of the Society of Arts, London, a machine was exhibited, intended to enable persons to write, or rather print, without using a pen. The *Journal of the Society of Arts* says:

The machine in appearance somewhat resembles an ordinary sewing machine, being mounted on a stand of the size and appearance of a sewing machine stand. In front there is a keyboard with the letters of the alphabet, numerals, &c., upon it, and on pressing one of the keys, a small lever, bearing the corresponding letter, is caused to strike against a ribbon saturated with a prepared ink, over which the paper is held on a roller. Each letter strikes

in the same spot, but the roller with the paper moves a space forward after each letter, so that it appears on the paper in its proper place. The mechanism is very simple, the levers carrying the letters being actuated by a similar arrangement to that of a piano, and strung on a circular wire so that they all strike into the centre of the circle. By the action of a treadle, as soon as a line is finished, the roller is traversed back to its original position, and at the same time is revolved one tooth of a rachet wheel, so as to bring a fresh line under the operations of the apparatus. The type is all small capitals, and the printing is perfectly regular and even. It is stated that after a little practice, any person can work twice as fast as an ordinary writer, and that a skilled operator can gain a very much greater speed. The machine can be used for manifolding with the ordinary thin paper and carbon paper, some nineteen or twenty legible copies being obtainable. It is an American invention.

A Type-Setting Machine.—Near the town of Nordhausen, in the province of Saxony, lives a certain Herr Henze, M.D., who has invented a new type-setting machine, of which we receive the following particulars:—By means of a lever, which is worked by s series of notes, something like a piano, the letters are raised out of the box in which they are kept, and placed in a position fixed for them. By employing a very simple mechanism a second setting apparatus can be adjusted, and by this means the sentence is twice set in the same time. The machine is of the simplest construction, and yet can be worked easily, and performs the setting in a quick and correct manner. Three compositors cannot work so quickly and surely as one with such a machine. The price of the new invention will vary from 30 to 60 thalers.

Horse Cleaning by Machinery.—A test trial of Newton, Wilson, & Co.'s "patent horse and cattle groomer" took place in March, in the Agricultural Hall, with satisfactory results. The object of the new apparatus is to supersede the present mode of grooming by a revolving brush of bristles, worked on much the same principle as that employed in hair-dressing by machinery, with the exception that the rotatory motion can be reversed by means of a spherical handle, which can be put at any angle. The machine is simple and portable, being no bigger than an ordinary grindstone, and can be driven by hand or steam. The currycomb and wisp are entirely dispensed with, and from what was practically shown, there can be no question but that the grooming can be done expeditiously and much more thoroughly than by hand. The animals were brought in from the streets, and for the most part took the operation very easily. After a few minutes under the brush, which they seemed to like as soon as the novelty had worn off, they were turned out as glossy as varnish. Not a greasy stain would come off on a silk handkerchief. The gain of this novel invention appeared to us to be less in the saving of labour and time than in the effective manner in which the skin was cleaned. The coat, of course, is rendered shiny, but that can be produced by malt, or balls, or heat (all of which are injurious to a horse's health); but skin with the scurf driven out from the roots of the hair is a desideratum which the owners of many studs sigh for in vain. Very good judges considered that a neglected animal could be brought into better condition in a quarter of the time by "the groomer" than by any amount of grooming in the ordinary way.

A Large Paper-Making Machine.—A new paper-making

machine, probably the largest ever made in the United States, has just been completed at the Gavit Machine Works in Philadelphia, the total length of which is 90 ft., and weight over 50 tons. The machine is what is termed a 98-in. Fourdrinier machine, capable of making a sheet of paper 92 in. wide, at the rate of 125 ft. per minute. The machine was built within eight weeks from the time of commencement, and is intended for the *Public Ledger* mills, near Elkton, Maryland.

Paper-Box Making Machinery.—American machines of unusual merit, and characterised by remarkable ingenuity in design, for the manufacture of paper boxes, have been for some months at work at New Cross, and promise to create a complete revolution in an important industry.

Without counting the pulp-making apparatus, which possesses no especial feature of interest, there are five distinct machines, each of which advances the box one stage towards completion. In the first of these machines the pulp is pumped into a small cylindrical receiver, provided with a discharge pipe, through which the surplus pulp is pumped away at each stroke of the machine. Within this cylinder two pistons—one working within the other—are moved up and down by cams, the outer one being in advance of the other and cutting off the supply of pulp, and the inner one following it, and exerting a powerful pressure on the top of a core box, which has been brought underneath it, and immediately in the centre of the mould, which is as much larger in diameter than the core box as corresponds to the thickness of the sides of the box. The core box is of brass, perforated with a large number of openings, and, before it is brought under the piston before mentioned, it is covered with a sheathing of fine wire gauze, which allows the water to flow away freely, but prevents the pulp from escaping. The core boxes, of which there are several attached to the machine, are carried at the ends of arms revolving freely around a vertical central spindle, and as each one is brought round automatically within the mould, its underside forms a tight joint with the top of an open pipe in connection with an exhaust-pump, driven by the machine, so that the perforated cores form vacuum boxes, through which the water flows from the pulp, while through perforations around the lower part of the cylinder, corresponding to the position of the flange of the box, the water from that part is also expelled. One of the most ingenious features of this machine is the arrangement of the brass mould surrounding the core box. It is of brass, formed in eight pieces, and so designed as to expand and contract without parting at any of the joints. Each piece is attached to a slipper working to and fro on a guide, and to a short connecting rod attached to a strong cast-iron ring. By a suitable mechanism the ring is made to travel to and fro through a small portion of its circumference, one movement expanding and the other contracting the mould, the latter motion taking place when the inner piston descends and compresses the pulp on top of the core to form the top of the box. This contraction of the mould exerts a very powerful pressure around the sides of the boxes and consolidates the pulp.

As soon as the body is thus formed, the core travels around and a new one takes its place within the mould, while the body is placed upon an endless chain, and deposited automatically in a drying stove, where it remains for twenty-four minutes, the rate of discharge being ten per minute, corresponding to the number of boxes moulded in the same time on the first machine. The next operation is to place the boxes in the

flanging machine. Two bodies are treated at a time in this machine. They are placed each on a mandrel, which revolves at a high speed and then stops automatically long enough for the boy working the machine to remove the body and put on another. The bodies are held upon the mandrel and caused to revolve by a driver consisting of a disc, rising and falling automatically, the former motion bringing the disc fairly against the bottom of the box, and the latter throwing it down clear, so that the body can be removed as soon as the mandrel is at rest. When the body is revolving, a circular brush, charged with china clay and water, presses against the flange of the box, and softens it, while, immediately after, a moulding tool rises and reduces the flange to the desired form.

In the succeeding machine the box bodies are placed on projecting pins attached to a long endless chain hanging vertically, and the upper parts of which are enclosed in two wooded trucks charged with heated air. As the bodies are placed on the pins, the chain revolves and brings the bottom and sides of the box into contact with colour brushes, which cover the whole surface; the box then passes upwards, giving place to another, and so on, the bodies travelling up one trunk and down the other until they arrive near the point where they were first placed on the chain. Here they are covered with china clay, and brought into contact with revolving and polishing brushes. Finally the boxes are placed in the last machine, an embossing press, in which the top and sides are stamped, and, if necessary, gilded at one operation.

The advantages connected with this interesting manufacture are very apparent. As the boxes are made from the pulp direct, all the preliminary expense of manufacturing materials is saved, there is none of the waste of material inseparable from the making of boxes by hand, and finally, a plant consisting of the four machines and drying stove, can produce 600 finished boxes or covers an hour without the employment of skilled labour, one boy to each machine being all that is necessary.

The Keely Motor.—There was much talk this year in American scientific circles about the Keely Motor. Mr. Keely, a poor workingman, declares that by means of a machine which he has invented he can, without the use of fuel, and by merely turning a handle, generate out of water a vapour so much more powerful than steam that with a gallon of water he can drive a heavy train from Philadelphia to San Francisco; and with a hogshead he could impel a Cunard steamer from Liverpool to New York against a continuous westerly gale. Of course the inventor has been well laughed at, but he induced Mr. Collier, a well-known American patent solicitor, to examine into the matter, and he was so struck with what he saw that he got a scientific man to verify it. Both agreed that Keely did actually produce extraordinary results, but they could not tell how these results were obtained. The chief engineer of the United States navy, who witnessed the experiments, was equally assured that the thing was actually done, but equally at a loss to explain the doing of it. Mr. Collier then formed a company at New York, explaining to them exactly how the affair stood. A small capital for carrying out the preliminary experiments was raised. Later on the same people raised a further capital of 100,000 dols. among themselves, without applying to the public. Of this sum 50,000 dols. was due to Mr. Keely, but he has refused to receive a cent until the world has been thoroughly convinced of the reality of his in-

vention, and until patents have been secured in every country. It is difficult to believe that the alleged invention is substantial, though our fathers would have found it equally difficult to believe that by turning a handle a man could communicate almost instantaneously with a country thousands of miles away. One thing is certain, that if there is anything in this new motor, the traffic and commerce of the world will be revolutionised; railway shares will become enormously increased in value, for trains will need no fuel to drive them, and coal mines will become a drug.

The view ordinarily entertained regarding this alleged discovery may be seen from the following account of a pretended interview with the inventor:—

"'If I have good luck, and no further breakages, I think I shall be able to exhibit the motor at work to the directors of the company and those of the public who choose to come, about June 1," said Mr. Keely, the chief proprietor of the new engine which is to revolutionise the procuration of force, as he escorted a reporter into a workshop in the rear of his residence. 'You cannot conceive,' he continued, 'the power of this machine, and what we had to overcome in experimenting. This register shell, for instance, weighs 7,000 pounds, although it is only 42 inches in diameter outside and 30 inches inside, being 6 inches thick. It is spherical, is of wrought steel, and holds 61 gallons. It took two weeks to cool after manufacture. I can charge it in less than one second with vapour, generated by about three thimblefuls of water, that will run a five hundred horse-power engine nine hours. This gauge registers 54,000 pounds to the square inch—4,000 pounds over that of gunpowder. We have tested it eight times. The safety-valve which you see here,' and Mr. Keely touched with his foot a wrought-iron pipe a foot in diameter, and three inches in thickness, which enclosed loosely a smaller pipe, 'cannot do much harm if it bursts, as the outer case prevents the piece flying. Here is one we split,' and he placed his hands on a huge 'valve' that had been riven like a reed. 'The material we now use almost entirely is of steel, forged in solid masses and bored out. The compressing cocks which are attached to that cylinder are my own invention. Understand what we are fighting against is thirty tons to the square inch. This machine will develop 85,000 horse power—enough to run all the cars in Philadelphia and New York put together—and can be charged with 70 gallons of pure vapour per minute. We have about fifty men employed, all told. That patch in the wall is where a bolt that blew out went though a short time ago. The greatest care is needed, and yet some of our appliances appear very fragile. This copper tube, which you see is not much thicker than a lead pencil, and has a passage not larger than a pipe-stem, will stand a pressure of 100,000 pounds to the square inch. The present century has given birth to many marvels—steam, telegraphy, &c.—and we are going to astonish the world in a greater measure than even great scientists can imagine. You may tell your readers that, barring accidents—do what we may, these will happen—the motor will be in working order by the 4th of July.' The interview then terminated."

XXI.—MANUFACTURES.

Making Screws on a Large Scale.—The Union Steel Screw Works of Cleveland, Ohio, possess the patent for the manufacture of screws from Bessemer steel, and the works are, with one exception, the largest in the United States. The building capacity of the works is equal to the production of ten thousand gross of screws, of all merchantable sizes, per day. The whole work of screw-making proper is done by machinery, and so perfectly is the mechanism adjusted to the requirements that human agency bears but a small fraction of the labour and responsibility, one young girl being able to attend to as many as twenty-seven of the intricate machines. After the wire is straightened and cut to the proper lengths, it passes through an automatically-fed "shaver and nicher," which turns down the heads and cuts the niche. These machines complete their portion of the work at the rate of twelve blanks per minute. The screw is then passed to the "threaders," which turn the point and cut the thread, at the rate of fifteen gross per day. A large number of these machines are used. The machines are necessarily somewhat complex, as may be inferred from the fact that the company have from twenty to thirty thousand patterns, which represent the different parts.

Steel Cut by Friction.—Professor Benjamin S. Hedrick read a paper at the meeting of the American Association for the Advancement of Science explanatory of the mode and essential character of the operation by which soft iron is made to cut hard steel. The development of heat by friction has been known for ages. A more recent discovery is, that the operations of rolling and rubbing have the effect of changing the molecular structure of iron and steel, toughening and rendering more compact even cold iron, and hardening as well as condensing steel.

In the *Tribune's* letters from Pittsburg, at the time of the Engineer's Convention there during last June, the operations of a soft iron circular saw at a high velocity, used in cutting steel, were described. Mr. Jacob Reese, of that city, had been endeavouring to construct a machine to cut hardened cold steel. He accomplished it at length by means of a saw of soft wrought iron—merely a circular disc—rotating at a high velocity. With low speed this would not cut at all, but when running at about 25,000 ft. per minute the disc cut through steel rapidly, giving out an immense cascade of sparks in the operation. It was found on examining the *débris* beneath the disc, that the particles of steel were not simply rubbed off; they were welded together in a pyramid like a stalagmite, or the snow icicles formed on the top of Mount Washington.

Professor Hedrick ascertained that real fusion had taken place among the particles of steel. The disc itself is very little heated, but the steel is actually melted and drops down; yet the bar on each side of the cut is not heated enough to draw the temper or to oxidise the metal. Solid bars of steel of 2 in. or 3 in. in diameter are thus cut through in as many minutes. The soft metal disc is about 42 in. in diameter. The naked hand may

be passed through the jet or stream of flying sparks during the operation without being burned, since the particles of melted metal are in the condition known as the spheroidal state.

A Cement for Iron.—The following is an iron cement which is unaffected by red heat :—Four parts by weight iron filings, two parts clay, one part fragments of a Hessian crucible, or of a piece of fire-brick; reduce to the size of rapeseed and mix together, working the whole into a stiff paste with a saturated solution of salt.

To make Cast Iron look like Bronze.—The following is a method of giving cast iron the appearance of bronze without coating it with any metal or alloy. The article to be so treated, is first cleaned, and then coated with a uniform film of some vegetable oil ; this done it is exposed in a furnace to the action of a high temperature, which, however, must not be strong enough to carbonise the oil. In this way the cast iron absorbs oxygen at the moment the oil is decomposed, and there is formed at the surface a thin coat of brown oxide, which adheres very strongly to the metal, and will admit of a high polish, giving it quite the appearance of fine bronze.—*Engineer*.

Steel Making at Home and abroad.—According to recently published statistics, there are in

	Bessemer Steel Works.	Converters.
England	21 ...	105
Prussia	14 ...	61
Bavaria	2 ...	4
Saxony	1 ...	4
Alsace	1 ...	2
Austria	12 ...	30
France	8 ...	25
United States	8 ...	16
	67	247

A new Ironmaking Process.—The members of the Manchester Scientific and Mechanical Society paid a visit, in the end of July, to the Standard Iron and Steel Works Company (formerly Bolckow, Vaughan, and Co.), Gorton, to inspect a new process for making iron and steel, patented by Mr. Samuel R. Smyth. About six or seven tons of common scrap iron were melted in an ordinary cupola, and run into a Bessemer converter, the current of air from the blowing engines being used to introduce certain chemical compounds and reagents into the molten metal for the purpose of eliminating impurities. This was done at a sacrifice of only a small percentage of iron. The process of refining and purifying occupied between nine and ten minutes, and the quality of the production appeared to be in every way satisfactory. Both gray and white iron can be produced of a high specific gravity and of great density.

A number of test bars made by Mr. Smyth's process from grey iron were submitted for inspection. The cast-iron test-bars were 1 in. square and 4 ft. 8 in. long, and at the time of testing were placed upon supports 4 ft. 6 in. apart. The weight was suspended in the centre upon a knife edge, the deflection measuring every 100 lb. up to 600 lb. The total deflection was found to be 1·375 in. The weights were then gradually removed, and when all were off, the deflection was found to be about 0·062 of an inch only. The weights were again placed in the scale, and the deflection again taken. When 720 lb. was registered the deflection was 2·078 in. The average breaking weight of five samples was 733·6 lb. The material works as easily as ordinary cast-iron. It is intended to erect an apparatus for making wrought-iron of high quality in large masses without piling or welding.

A Thick Armour Plate.—The *Sheffield Daily Telegraph* says Messrs. John Brown and Co. have

successfully rolled the thickest armour plate yet produced. It is twenty-four inches in thickness, and is believed to be invulnerable to the heaviest artillery.

Large Ingots of Steel.—Two ingots of steel have been recently moulded at the Ebbw Vale Works, which are believed to be the largest ingots ever cast there. They weigh a ton and a half each, and are to be kept as specimen pieces.

Iron Sheets thinner than Paper.—We have heard of iron as thin as paper, but have just had a packet of specimen iron sheets brought to our office not half as thick as the sheet this is printed on. This sheet is ·004 inch in thickness; the iron sheets we have received are ·0015 inch thick, or only three-eighths of the thickness of the paper. At the same time the iron sheets are so tough as to be torn with difficulty, and so flexible as to bend with almost the facility of ordinary printing paper. These wonderful specimens of iron were made from the rough pig up to the rolled sheets by the Pearson and Knowles Coal and Iron Company, whose skilful manager, Mr. Hooper, has discovered a means of rolling these infinitesimally thin sheets in numbers, without their sticking together.—*Warrington Guardian.*

Previous to the appearance of this paragraph we had heard that Messrs. Graff, Bennett, and Co., proprietors of the Millvale Iron Works, Pittsburgh, had produced what was claimed to be the thinnest iron that had ever been rolled anywhere—15,500 leaves being necessary to make an inch in thickness. It was rolled on ordinary plate rolls, upon which plates weighing from a ton to a ton and a half have been rolled, and the iron used was puddled bar made in a Danks furnace.

To Preserve Iron from Rust.—Mr. J. Machabee has invented a composition to preserve iron from rust, applicable also to other materials, such as stone or wood, used in conjunction with metal. The following is the composition:—Virgin wax, 100 parts; Gallipoli, 125; Norwegian pitch, 200; grease, 100; bitumen of Judea, 100; gutta-percha, 235; red lead, 120; and white lead, 20; each having its special value. These ingredients are mixed together in a boiler in the order above, the gutta percha being cut up in small pieces or rasped. The mixture is stirred at each addition and poured into moulds. For iron it is melted and laid on with a brush; for stopping holes it is used as a paste. It may be used also as a glue for stopping holes in large vertical metal surfaces by a slight alteration in the proportions: viz., Gallipoli 115, bitumen 90, and red lead 100; and 40 parts of copal gum are added after the gutta percha.—*Engineer.*

Japanese Iron.—In a foreign technical serial we have the following account of Japanese ironworks: The blast-furnaces of Japan are small, and of very simple construction, although built on the same principle as those of Europe. The walls are built of fire-proof clay, mixed with a few stones. The blast furnaces are round, and have an opening at the side, closed by a band of clay; opposite are two other openings, through which comes a strong current of air, driven into the furnace by Chinese bellows worked by men. Before pouring the ore into the furnace they mix it with coal, and subject it to a previous calcination, so as to get rid of its carbonic acid and sulphur.

The Japanese do not understand puddling as practised in the West; but the principle of their procedure is exactly the same. The fused iron, mixed with a little sand and pieces of iron, is again fused with charcoal in a second furnace, where it is left to cool for several days until the

whole mass has the appearance of fluid. The Japanese method of making steel is quite different from that practised in Europe. They mix a certain quantity of iron in pigs and iron in bars, cover the quantity with borax, and melt the whole for a week in a small fire-proof crucible. The borax serves to dissolve the impurities in the dross. When the metal is separated from the dross, which floats on the surface, and cooled, it is hammered hard, and alternately plunged into water or oil, after which it is cemented and tempered.

The mode of cementing is as follows:—The steel, on coming from beneath the hammer, is covered with a mixture of clay, cinders, marl, and charcoal powder. When this plaster is dry, the whole is subjected to a red heat, and the steel is afterwards cooled very slowly in warm water, which is allowed to become tepid.

Steel thus obtained is not very supple, but extremely hard, because it is not properly tempered or completely freed from its impurities. It would not do for making watch-springs, but is used by the Japanese for swords and sabres, which are tempered as many as eleven times, and knives, which are tempered four times.

Dangerous Cotton Goods.—Prof. Gintl says that some cotton goods sold in Austria recently contained from 15 to 25 per cent. of arsenious acid to the yard. It appears to have been introduced with the glycerine and alumina in the mordanting process for aniline colours.

The Silk Crop of 1874.—According to a report just published by the Syndicate of the Lyons Union of Silk Merchants, the silk crop of Europe last year was, in round numbers, 9,050,000 lb. of raw silk, while there were exported from Asia 11,500,000 lb., making upwards of 20,500,000 lb. of raw silk available for European consumption. The countries included in the report are Italy, France (with her dependencies, Corsica and Algeria), Spain, Greece, the Turkish Empire, Georgia, Persia, India, Japan, and China. The first and last together supply four-fifths of the silk used in Europe. China exported, chiefly from Shanghai, upwards of 8,000,000 lb. The crop of Italy amounted to 6,300,000 lb. France supplied 1,600,000 lb.; Spain, about 310,090 lb.; Greece, less than 30,000 lb.; the Turkish Empire, 1,180,000 lb.; Georgia and Persia together, 880,000 lb.; India (from Calcutta), 935,000 lb.; and Japan, something over 1,200,000 lb.

Red Glass and Rose Glass.—In the *Bulletin de la Société d'Encouragement*, M. Baccarat describes how the far-famed French rose and red shades of glass are produced—one of the most critical and beautiful of the arts of industry. A certain quantity of auriferous glass is prepared beforehand, and run in thin plates, and fragments of these plates are used by the glass-blower to fuse upon his work, and thus give it a superficial colouration. It often happens that one and the same composition of auriferous crystal gives plates of very different shades, some colourless, others tinged more or less deeply with rose and red, and some almost black; these differences being due to two causes—namely, the temperature of the furnace in which the fusion has been effected, and the temperature of the mould into which the melted metal is run. For light-coloured plates the temperature of the furnace is made low, and the mould very cold; blue plates are sometimes produced under the same circumstances, which, if re-heated, take the normal colour, as do also the colourless and very pale rose glasses.

The curious facts thus developed,

in regard to the process in question and its results, render it probable that the colouring matter is neither a salt nor an oxide, but a simple body. Crystal coloured with gold is therefore merely a vitreous matter, holding in suspension metallic gold in a state of very fine subdivision. It is stated that on attentively examining the red plates, it is easy to recognise in the mass a multitude of most brilliant specks of metallic gold, forming a sort of adventurine.

Glass from Slag.—Before a recent meeting of the North of England Iron and Coal Trade, slag was exhibited in a fibrous form, and a company is in process of formation to manufacture slag into glass, under a patent. The slag is taken as issuing from the blast furnaces, conducted into a tank, and there mixed with other materials, from which mixture transparent glass is made. The new glass is said to be acid proof, and capable of use for all purposes for which the best bottle glass is suitable. It is alleged that the saving in the process has been shown to be so great that it is likely to bring about important changes in the glass manufacture.

Another use for Glass.—Glass bearings are now being made in the United States. Those of ordinary glass sustain a pressure of 10,000 lb. per square inch before cracking, while others made of a special glass require upwards of 27,000 lb. to break them. They do well without lubricants, but a little oil is an improvement. Some are in use on goods-waggons, and others have been tried in saw-mills with good results.

A Wonder in Glass-making.—An enormous glass cylindrical shade or cover for a statue was recently made in Somerville, Mass. It was made by the following process:—A long hollow iron tube was inserted into the pot of molten glass, and by careful manipulation about seventy-five pounds of the latter was caused to adhere to the tube. This was then taken to a wooden mould of semi-circular form, in which it was rolled a few times by three men, and thus brought to a white heat. It was then taken to a wooden cylinder placed beneath the floor of the factory; and after it was placed therein, the work of fashioning the cylinder to its proper proportion was begun, which was done by blowing through the iron tube and into the body of the glass; while at the same time two men raised and lowered the glowing cylinder gently but quickly until it came forth finished. It measured five feet in height and seventy-four inches in circumference.—*Titusville Herald.*

Gilding on Glass.—Professor Schwarzenbach, of Berne, has recently devised the following new method of gilding on glass:—Pure chloride of gold is dissolved in water. The solution is filtered and diluted until, in twenty quarts of water, but fifteen grains of gold are contained. It is then rendered alkaline by the addition of soda. In order to reduce the gold chloride, alcohol, saturated with marsh gas and diluted with its own volume of water, is used. The reaction which ensues results in the deposition of metallic gold and the neutralisation of the hydrochloric acid by the soda. In practice, to gild a plate of glass the object is first cleaned, and placed above a second plate slightly larger, a space of about one-tenth of an inch separating the two. Into this space the alkaline solution is poured, the reducing agent being added immediately before use. After two or three hours' repose the gilding is solidly fixed, when the plate may be removed and washed.

Tempered Glass: Herr Siemens' Process.—The well-known Dresden manufacturer, Herr F. Siemens, has recently patented a method of hardening, tempering, and

pressing glass, which appears likely to become of more practical utility than the process of hardening discovered by M. de la Bastie. It consists in a method of beating and then suddenly cooling the glass to be hardened or tempered; but when the articles are such as are usually moulded, the hardening and tempering are accomplished at the same time as the pressing—*e.g.*, the molten glass is run into suitable moulds, and while still highly heated is squeezed, the moulds having the effect of giving the necessary cooling without resorting to the liquid bath of M. Bastie.

The material employed for the moulds depends on the nature and thickness of the glass; in cases where the cooling process must necessarily be a rapid one, metals of good conducting power, such as copper, are preferred, while in those where the cooling has to be effected more gradually moulds of earthenware, or other bad conductors of heat are employed. In cases where the glass articles to be operated upon vary in thickness the conductivity of the parts of the moulds is varied accordingly, either by means of thicker metal near the thicker parts of the glass, or by making those parts of the mould of a better conducting material than the parts next the thinner portions of the glass. The moulds, too, must be kept at certain temperatures varying according as the nature of the glass requires that they should be cooled to a greater or lesser degree. In ordinary practice, however, it is found that cast-iron moulds maintained at a temperature of boiling water or thereabouts, and earthenware moulds kept quite cool, yield very satisfactory results.

The liquid glass may be conveyed direct into the moulds, or may be taken from the melting-furnace on the blower's pipe and shaped in the mould, but it is preferable to heat the articles after shaping or partial shaping before pressing and cooling them. This part of the process introduces the difficulty of keeping the articles in shape, and it is overcome by Herr Siemens by means of casings or shells of platinum, such shells being transferred to the mould with the glass to undergo the pressing and hardening process. The heating ovens may be of any suitable construction, but Herr Siemens prefers to employ regenerative gas muffle ovens, heated under the floors and over the crowns by the flames of gas and air, which pass from one set of regenerators to another, which latter becoming sufficiently heated, the currents are reversed in the well-known manner of alternated working. The muffle being completely closed in, the articles are protected from dust and other impurities which in the open furnace are apt to settle on and damage the surface of the glass.

The lower halves of the moulds are mounted on trucks or hand carriages, and are run up to the furnace mouth or the oven, as the case may be, and having received the glass are run under the respective upper halves, which may be loaded to give the desired pressure. The temperature of the moulds is kept at the required point by supplying them with liquid, and water at the boiling point is found to be well suited for the purpose. Herr Siemens claims the process described of producing hard pressed glass by treating it whilst heated in moulds at a lower temperature, whereby it is simultaneously compressed and hardened. He also claims the use of moulds having parts of varying thickness, or of different materials having various degrees of conductivity. A separate claim is also made for the use of the platinum moulds to maintain the articles in shape whilst being heated in the muffle.—*English Mechanic.*

Tempered Glass: other Processes.—Some considerable time has elapsed since De la Bastie first manufactured his tempered glass and obtained his first patent. Specimens of tempered glass are to be bought at a few shops, but at present it does not seem to have taken that prominent position which was confidently predicted for it when it was first announced, and the reporters had seen specimens and tested them in the City of London.

It is unquestionable that to De la Bastie belongs the honour of first bringing the art of tempering glass to a practical issue; but his rivals seem determined to forestall him in those improvements which will make the invention commercially successful. It seems that some difficulty is experienced with the bath of grease or paraffin which De la Bastie uses for tempering his glass; and he has had to devise a means of preventing the ignition of the inflammable constituents of the bath, which means has to some extent added to the complication of his process.

In the presence of this difficulty other inventors found their opportunity, and, besides the process invented by Herr Siemens, of Dresden, described in the preceding paragraph, Herr Pieper has also devised a method of tempering and hardening glass, which is so far successful that the German glass-makers have given 15,000*l.* for the exclusive right to use it in their country.

The new process consists in submitting the glass, while at a red heat, to the action of superheated steam, a process which of course effectually disposes of the difficulty and danger attendant on the use of an inflammable bath. Although the German glass-makers have purchased Pieper's patent, it does not appear that its practical success has been fully established, though it is obvious that if the superheated steam will effect the same changes in the glass as the dip into the heated oil of Bastie's bath, and effect them as rapidly, M. de la Bastie will lose that pecuniary reward which his discovery merits.

The steam process, too, would appear to remove the difficulty which is found in tempering shaped articles of glass—a difficulty which Herr Siemens surmounts by making costly platinum sheaths or moulds, with which he protects the articles during the hardening operations.

Amongst the minor rivals of De la Bastie may be mentioned Herr Meusel, of Thüringen, who has so far modified the original process that he plunges the blown articles while still on the tube into the tempering bath, which is composed of similar substances to those employed by De la Bastie. The latter, on the contrary, shapes the articles in the ordinary way, and then re-heats them before plunging them into the tempering bath. The original process is not likely to suffer much from the competition of Herr Meusel, for it yields far better and more regular results in practice, as it is found that, however quickly the blown glass may be transferred to the bath, the portion attached to the blower's pipe or tube is so speedily cooled by the surrounding air that it is impossible to obtain the desired effects in the tempering bath.

There are several modifications of the tempering process, including the English patent of Mackintosh, under which the glass is submitted to the action of a very low temperature; but, with the exception of the processes of Pieper, Siemens, and the original Bastie, none of them seem likely to soon furnish us with an article for which there is already an inquiry, and for which there will undoubtedly be a considerable demand, if it can be supplied at a reasonable price.—*English Mechanic.*

A New Emerald Green. — Any pigment which approaches in beauty the fearfully-poisonous Paris green certainly deserves attention. One of these is said to be an hydrated oxide of chromium, prepared in a peculiar manner and known as Guignet's green. We doubt the statement that it is not poisonous; but it is, at all events, far more harmless than Paris-green, or any other arsenical colour. It is prepared on a large scale by fusing together, on the hearth of a suitably-constructed flame furnace, at a dark red heat, three parts boracic acid to one part bichromate of potash. The mass swells up, much oxygen gas is evolved, and the substance is finally converted into a beautiful green double salt, a borate of chromium and potash. By repeated washing with boiling water, it is decomposed with hydrated oxide of chromium and a soluble borate of potash. After suitable washing and very fine grinding, this oxide of chromium has a most beautiful shade of colour, covers well, stands the air and light, and is only attacked by boiling concentrated acids. On a small scale, this green pigment may be prepared in a porcelain crucible.

Uninflammable Cloth. — M. L'Abbé Mauran has "discovered" that a mixture of borax, sulphate of soda, and boracic acid will render cloth uninflammable, and prevent any loss of colour, flexibility, or other property from the effects of fire.

A New Pigment.—Mr. Luke Nattrass, of Nelson, New Zealand, has prepared a new indigenous vegetable pigment from the hinau tree (*Elæocarpus hinau*). It is considered to be as good as sepia.

Coloured Liquids.—To obtain bright and permanent coloured liquids it is best to use the neutral metallic salts, that have neither tendency to oxydise or reduce. The aniline salts yield a beautiful solution, but are not permanent. *Blue:* Sulphate of copper, 2 ounces; oil of vitriol, ½ ounce; water, q. s. *Red:* Dissolve No. 40 carmine in aqua ammonia, and dilute with water to the desired shade. Filter. *Yellow:* Bichromate of potash, 2 ounces; muriatic acid, q. s.; water, q. s. Dissolve the bichromate of potash in the water; add the acid to set colour, and filter. *Green:* Sulphate of copper, 2 ounces; bichromate of potash, q. s.; water, q. s. Dissolve the sulphate of copper in a portion of the water, add the bichromate of potash to give the desired shade; add water, and filter.

Green Bronzing. — The repeated applications to copper or brass of alternate washes of dilute acetic acid and exposure to the fumes of ammonia will give a very antique-looking green bronze; but a quick mode of producing a similar appearance is often desirable. To this end the articles may be immersed in a solution of 1 part perchloride of iron in 2 parts water. The tone assumes darkness with the length of immersion. Or the articles may be boiled in a strong solution of nitrate of copper. Or, lastly, they may be immersed in a solution of 2 oz. nitrate of iron, and 2 oz. hyposulphate of soda in 1 pint water. Washing, drying, and burnishing, complete the process.

Instantaneous Bleaching Fluid.—In 5½ pints of water, heated to 190° or 212° Fah. are introduced successively: mother-of-pearl, 3½ oz.; indigo, 0·75 grains; cochineal, 0·75 grains; chloride of lime, 150 grains; soda crystals, 150 grains; potash, 150 grains. Boil for half-an-hour, and the preparation is ready for use. The inventor, M. Boiselier, says:—"The mother-of-pearl gives softness, lustre, suppleness, &c., and gives to hemp the feel of cashmere; the indigo gives a slight azure tint, the cochineal adds brightness, the chloride affects

the bleaching, the soda washes and brushes, and the potash removes all grease."

A New Aniline Red.—Dr. Isidor Walz has called attention to the discovery of a new coal tar colour which promises to become of importance. It yields shades exactly like those of cochineal and almost as fast. A sample of wool dyed with it was scarcely affected by a week's exposure to the sun. The discoverer is a New York chemist.

A New Black Printing Colour.—According to Knaffl, if vapour of turpentine is passed over sesquioxide of iron (Colcothar vitrioli) at a red heat, a black pigment results, surpassing printing-ink in softness, lightness, and depth of colour, and said to be adapted to printing from stone, copper, and steel.

A New Paint-Solvent.—It is stated in a Suffolk paper that Mr. H. P. Hayhoe, painter, of Bury St. Edmunds, has invented a new paint-solvent. The solution is simply applied to the paint with a brush, and is then left for a short time, after which the paint may be scraped off with ease. The number of coats of solution depends upon the number of coats of paint; four, which may be applied within a quarter of an hour or so of each other, will probably be sufficient in the most hardened case. The solution, which it is alleged causes no injury whatever to the hands or to the brushes, is inexpensive, and produces no smell.

Dyeing Cotton Pure Blue.—Böttger suggests the following process for dying cotton pure blue:—Heat a mixture of 137 grains Paris blue, 137 grains tartaric acid, ½ fluid ounce ammonia water, and 2½ fluid ounces water, and filter after cooling. Add to the deep blue filtrate a solution of caustic soda, until it is decolourised, and after some time assumes a light yellow tint. Impregnate the cotton with this solution and pass it (best after allowing it to dry) through a warm, very dilute solution of sulphuric acid, and it will immediately assume a beautiful blue colour, and needs only to be washed in water. The sulphuric acid may be so diluted that it has scarcely a perceptibly sour taste.

Baryta Green.—Böttger recommends the following mode for the preparation of baryta-green:—Add gradually two parts of finely-sifted peroxide of manganese to a mixture of two parts of caustic potash and one part of chlorate of potash in a state of fusion, and finally heat the mass to a low red heat. Allow it to cool, powder it, pour cold water over it, filter, and add to the green filtrate, in the cold, a solution of nitrate of baryta. Wash well with water the beautiful violet neutral manganate of baryta that separates, and when dry mix with it ⅓ to one part of hydrate of baryta, and heat the mixture at a low red heat, in a rather shallow brass or copper vessel, with continued stirring until the contents, upon cooling, manifest a pure green colour. Finally, pulverise it thoroughly, and treat repeatedly with cold water, in order to remove any hydrate of baryta present.

Wood for Wall-Paper.—An improvement in the preparation of wood for wall-paper has been lately made in America. The wood is cut to the thickness of paper, and by a peculiar process stuck on to the paper, which serves as a protection against the influence of the walls on the graining and colour of the wood.—*Journal of the Society of Arts.*

Fire Lighters of Indian Corn.—Nothing is too small or unimportant to rescue from simple destruction, if it can be turned in any way to serve the purpose of man. As an illustration we may

mention the fact of the application as fire-lighters of the central portion of the ear of the Indian corn, after the seeds have been taken out; also of the cones of the Scotch fir (*Pinus sylvestris*), which are sold in France under the name of *allumettes des landes*.—*Nature.*

Lacquer-ware in Japan.—In his just published report to the Foreign Office, her Majesty's Consul at Yokohama gives some interesting information respecting the preparation of lacquer-ware in Japan. Some Japanese, he says, give A.D. 724 as the date when the art of lacquering was first discovered, but those among them who have given attention to the subject fix the date as A.D. 889 or 900. It would appear to have attained to some perfection in 1290, for the name of a distinguished painter in lacquer at that time is still handed down as the founder of a particular school of art in lacquer-painting. Having described the manner in which the lacquer-varnish is obtained, Mr. Robertson gives some details of the mode in which designs in lacquer are worked. "The first thing," he says, "is to trace out on the thinnest of paper the required pattern or design, and the tracing is then gone over with a composition of lacquer-varnish and vermillion, afterwards laid on whatever it is proposed to impart the design to, ... and well rubbed over with a bamboo spatula." The outline thus left "is now gone over with a particular kind of soft lacquer-varnish. When this industry is pursued in hot weather, the varnish speedily dries, and consequently, where the pattern is a good deal involved . . . . a small portion only is executed at one time, and the gold powder, which enters largely into most of the lacquer-ware for the foreign market, is applied to each part as it is being executed. For this a large and very soft brush is used, and by its aid the gold powder is well rubbed in with the lacquer or varnish. The work is then left to dry for about twenty-four hours, after which the pattern is lightly rubbed over with charcoal made from a particular kind of wood, this process securing evenness of surface. The work is next rubbed with polishing powder, and afterwards carefully wiped." After all this outlining has been done, "there still remains a good deal of finishing work, such as the tracing of leaves on trees, the petals of flowers, the wings of birds, &c. . . . . into all this the gold largely enters, the working in of which requires a light brush and a skilful hand . . After this has been well dried, a particular kind of lacquer-varnish, known as *yoshimô urushi*, is well rubbed in, and the whole is then polished with horn-dust. The polishing process is done with the finger, and is continued until the gold-glitter shows out well."—*Academy.*

A Decided Saving.—A new branch of industry, says the *Engineer*, has sprung up, which will be of great convenience to government works and other large factories. A contractor has come forward and agreed to purchase at a good price all the old "cotton waste," a material which, after being used to clean machinery, has hitherto been burnt as valueless. He has made terms with one large department of the Royal Arsenal, and carried away some tons of the waste. This he washes in some chemical solution, which entirely cleanses the cotton of grease and other impurities, and when dried, it is again as fit for use as when it first left the cotton-mills. The grease is clarified with fine oil and the refuse is sold to the soap-makers.—*Journal of the Society of Arts.*

A Use for the Suds from the Washing of Wool.—In nothing

has the advance of practical science been more clearly evidenced than in the extent to which substances formerly wasted and lost are now reclaimed and made to constitute an important element in the profits of the manufacturer. One of these applications consists in the recovery of soap-suds from the washings of wool in woollen factories. These were formerly allowed to run down the sewers and into the streams, to the great pollution of the latter; but in Bradford, they are now run from the washing-bowls into vats, and there treated with sulphuric acid. The fats rise to the surface in a mass of grease a foot or more in thickness, which is carefully collected and treated in various ways, mostly by distillation. The products are grease, used for lubricating the cogs of driving-wheels in the mills; oleic acid, which is worth about 30*l.* per ton, and used as a substitute for olive oil; stearin, worth about 80*l.* per ton, &c. It is said that some large mill-owners are now paid from 500*l.* to 1,000*l.* a year for these suds, which a few years ago were allowed to run to waste.

Yarn and Thread by a New Process.—At a meeting of the Sussex Natural Society, held at Brighton on the 11th of May, Mr. C. F. Dennett submitted samples of yarn and thread made directly from seed cotton by a new process. He stated that great difficulty had been hitherto experienced in regard to malpractices as to the manufacture of cotton, and that although considerable pains had been taken in the matter by the Marquis of Salisbury and Dr. J. S. Forbes Watson, they had not succeeded in overcoming the difficulty, it having remained for one of his American countrymen to discover a process by which the manufactured article could be transformed direct from seed cotton as it was brought in from the field by the negro. By this method he said, from 50 to 75 per cent. is saved in converting seed cotton into yarn, while it made better and stronger thread, &c., than can be made of baled cotton.

Artificial Leather.—The process by which artificial leather is prepared by Sören Sörensen, of Copenhagen, from leather parings and caoutchouc, is (according to the *Deutsche Industrie Zeitung*) as follows:—The parings are first freed from impurities, if any, and worked by a peculiar machine to a homogeneous fibrous mass. On mixing some ammoniac water, a gelatinous mass is had, which, pressed in moulds or rolled in plates, forms a very hard and stiff product, of considerable cohesion, but without elasticity and soluble in water. To remedy these drawbacks, caoutchouc is added. This, which may vary from the finest Para to the smallest African, is squeezed and washed in a washing machine consisting of two cannelated steel rollers; on these a jet of water is directed, both to wash the caoutchouc clean, and keep it from burning in consequence of the strong friction. Next the caoutchouc is dried, cut in pieces, and dissolved by oil of turpentine, benzine, sulphide of carbon, or other liquid, in suitable quantity. The substance is then mixed with ammoniac water and stirred. Then the prepared leather is added in a closed kneading machine. (The proportions of the ingredients vary thus: for sole leather they are 25 parts solid caoutchouc, 67 parts ammonia, and 67 parts leather). After kneading, the homogeneous mass is either pressed in moulds, or rolled, then dried, and in drying subjected to various progressive pressures, according to the quality desired.—*English Mechanic.*

Flour Mills.—The latest improvement in mills for grinding wheat, &c., consists in the use of

porcelain rollers for crushing the wheat previous to submitting it to the millstones. The result is an improvement in the quality of the flour, and a larger yield in a given time.

Paper as Hard as Wood and as Tough as Leather.—French manufacturers have a method of rendering paper extremely hard and tenacious by subjecting the pulp to the action of chloride of zinc. After it has been treated with the chloride, it is submitted to a strong pressure, thereafter becoming as hard as wood, and as tough as leather. The hardness varies according to the strength of the metallic solution. The material thus produced can be easily coloured. It may be employed in covering floors with advantage, and may be made to replace leather in the manufacture of coarse shoes; it is also a good material for whip handles, the mounting of saws, buttons, combs, &c. A great deal is used in large sheets for roofing. Paper already manufactured acquires the same consistency when plunged, unsized, in a solution of the chloride.

The Chemistry of Soap-making.—If grease, fat, or resin, which are commonly employed to make soap, are heated with an excess of common salt, ammonia, and water, a soda-soap separates, leaving chloride of ammonia in the liquor, together with the excess of ammonia and salt. This reaction is the consequence of the great solubility of ammonia soap in ammoniacal water, and the insolubility of soda soap in water containing more than ½ per cent. of salt. The ammonia at first unites with fatty acids; then the sodium in the salt exchanges places with the ammonia in the soap, forming, as we have said, a soda soap and chloride of ammonia. It is essential that there be an excess of ammonia and salt present in order that the reaction take place. One hundred parts of grease require 15 to 20 parts ammonia, 20 to 30 parts salt, and 200 to 300 of water.—*T. N. Whitelaw*, in *Chemisches Centralblatt.*

Paper Barrels and Pails.—Not only in Japan, but also in America, paper is used for many purposes that are still unusual with us. One of these is the manufacture of barrels and pails, which, instead of being made of many pieces of wood, are made either in one piece or in a few pieces of paper. The material of which the paper is made may be wood. But, by its mastication and manipulation, the wood is moulded into paper with a very important saving in material, and with a lighter, stronger, and more perfect product. Such paper is in reality artificial wood, and such materials may be mixed with it, when in a state of disintegration, as will make it stronger and better than the natural wood would be.—*Illustrated London News.*

Nothing Like Paper.—The *American Paper Trade Journal* thus describes a new adaptation of paper:—"The American Paper Car Wheel Company, of Hudson, N.Y., has specimens at the Philadelphia Exhibition of 30, 33, and 42-inch wheels of its manufacture. These wheels have steel tires made with an inside flange and a cast-iron hub. On each side of the hub and tire, wrought iron or steel plates 3-16 in. thick are bolted, and the space between the plates is filled with compressed, or rather, condensed paper. This paper is made of straw-boards ⅛ inch thick, pasted together with paste made of rye-flour, and first made into sections about ½ inch thick. These are subject to a pressure of about 400 tons for about five hours, and are then dried with hot air. These sections are then pasted together in the same way, so as to

get the requisite thickness, about $3\frac{1}{2}$ inches, and are again pressed and dried. They thus form a disc, which is turned off, and the tire forced on with a pressure of about 150 tons. The plates are then bolted to the inside and outside of the wheel with $\frac{3}{4}$ inch bolts. An old wheel is exhibited, 'one of the first paper car wheels ever made; it has run under a Pullman car 312,000 miles without the tire being turned.' One of the wheels is shown with a portion of the plates and paper disc cut away, so as to show the inside structure. One of the paper discs is also exhibited, and if a separate tire and hub were shown, the exhibit would be complete. The wheels are painted brilliantly red, which might be described as monochromo engineering."

Paper Imitation of Leather.—A most deceptive imitation of leather is manufactured, according to a process discovered by Dawidowski, from parchment paper. It is as soft and pliable as leather, and resembles it perfectly in colour and finish, and, like it, can be glued, pressed, stamped, gilded, &c. It therefore forms a perfect substitute for fancy leather for very many purposes. As binding of books it resists abrasion extremely well, and is not affected by dirt, or even water. It is also free from the objections to leather as a lining for hats, since it is unaffected by perspiration.

A New Paper Board.—A new method of manufacturing paper-board, to make that article more generally useful and durable, is described as follows:—When a sheet of paper is immersed in an ammoniacal solution of copper, and then dried, it is said to be quite impregnable to water, and does not lose this quality, even though the water be boiling. Two sheets of paper thus prepared, and passed through a cylinder, adhere to each other so completely as to be quite inseparable. If a large number of sheets so prepared be cylindered together, boards of great thickness are obtainable, the resistance and cohesion of which may be increased by interposing fibrous matters or cloths. The substance so prepared is quite as hard as the closest grained wood of the same thickness. The ammoniacal solution of copper is prepared by treating plates of copper with ammonia, of the density of 0·880 in contact with the atmosphere.

Casks made of Cement.—Wooden casks in damp cellars are liable to become unfit for use before long. On this account Herr Bollert determined to try casks made of mortar, covered over with Portland cement. When hard enough, they were filled with water, and exposed to its action for ten days in order to abstract the lime. This object was not accomplished, for in a few days it was found that the wine had lost all its acidity, and at the end of a fortnight a thick crust had formed on the sides. Good wine which was afterwards put in underwent no change for the worse, and for five years the casks have been in constant use, at least so says the German *Wine Gazette*. Fermentation and fining go on quite right. There is merely an insignificant loss of acidity, and rather a thicker crust than is usual with wooden casks. Herr Bollert has for several years had no wooden casks, nor does he want any, as the work of the cellar is much simpler and better without them. The advantages of cement casks are, a great saving of room, as they can be made much larger than wooden ones, greater solidity and durability, little loss of the contents, less cellar work, because there is no formation of fungus, less dampness in the cellar, and consequently less foul air, and, lastly, less expense for repairs.

The Most Costly Carriage ever Built.—Probably the most costly state chariot ever yet built has just been completed for the Mikado of Japan, by Messrs. Morgan & Co., her Majesty's coachbuilders. The body of the vehicle is of the finest Spanish mahogany, and fashioned after an old Flemish pattern, which allows of an unlimited amount of ornamentation and exceptional interior comforts. It is considerably larger than European state carriages generally, but the peculiarity of its construction admits of the draught being very light. The panels are painted a rich pale green, with white and gold trellis and scroll ornaments, the gilding being very profuse. The metal appointments are silver gilt, the door-handles and lamps being massive and richly chased. Traditional emblems of Japan, conspicuously the tortoise and dragon, surmount each corner of the roof, in the centre of which is a Japanese crown. The interior is luxuriously upholstered with cloth of gold, rich Valenciennes lace, and green silk velvet ornaments. The under carriage is scroll-shaped and richly carved and gilt, the colour of the wheels matching the body of the vehicle.—*Times*.

Paper from Peat.—Specimens of paper and cardboard made from peat were recently presented to the Berlin Polytechnic Association by Herr Veyt-Meyer. The cardboard was so thick that it could be planed and polished. Paper made of peat alone is like that made from wood or straw; but only fifteen per cent. of rags is needed to give it consistence. A large factory for the manufacture of peat paper is to be established in Prussia.

Phosphor-Bronze.—The manufacture of alloys known by the name of "phosphor-bronze," the invention of which is due to the founders of the Val-Benoît nickel manufactory near Liège, is rapidly developing. Many foundries established within the last two or three years are devoted to the successful working of these new products, both in this country and America. The result of analyses and observations hitherto made seems to be that phosphorus exercises a double chemical action over the metals which compose the alloys. While reducing on the whole the oxide of tin contained in the mixture, it at the same time forms with the metals it has thus purified a perfectly homogeneous alloy, the hardness and resistance of which are subject to control. The experiments made in London, Vienna, and Berlin, leave no doubt on this point, and establish the superiority of phosphorous alloys over ordinary bronze, copper, coke-iron, charcoal-iron, and steel. Under the influence of strains exceeding the limit of elasticity, or violent shocks, their texture does not become crystalline. They are completely free from metals easily liable to attack, such as zinc. Sea water, or diluted solutions of sulphuric acid, have only a very feeble action upon them, and in all cases much less than on pure copper. One of their most valuable qualities is, that recasting does not occasion the smallest loss in tin. Moreover, their degree of liquidity, which may be compared to that of mercury, renders it possible to obtain them without blisters, and to have perfect mouldings. Their degree of fusibility is nearly the same as that of ordinary cannon-bronze.

Their application to military art has led to very minute researches. Various European governments have had experiments made which have all established the superiority of phosphorous over ordinary bronze.—*Revue Industrielle*.

Lignose, a New Explosive.—According to the *Industrie-Zeitung*, the new explosive, lignose, appa-

rently woody fibre prepared with nitro-glycerine, invented by Trützschler-Falkenstein, is a very light powder, which in loose condition burns very slowly. The cartridges made of it are larger than those of ordinary blasting powder of the same power. As it does not withstand moisture it cannot replace dynamite. It has been employed in a number of mines, and the results of tests made of it, although not unfavourable, place its explosive force, which, however, does not seem to be uniform, at, at least three times that of an equal weight of blasting powder, instead of at five times, as claimed at first; the price has therefore been fixed by the manufacturer on the basis of the former, at something less than that of an equivalent quantity of powder. Great safety is stated as one of the advantages of its use, and it is said not to be exploded by contact with naked fire, and with difficulty by friction or percussion, while it can be used with a fuse in blasting. It is also said that but little, and that harmless, gas is left after explosion. In the *Polytechnisches-Centralblatt* an account, however, is given of the explosion and destruction of the building in which cartridges of it were prepared by women, by stamping it into cases, although according to tests made under Governmental supervision the occupation had been pronounced perfectly safe. The combustion of the cartridges, when first noticed, was so slow that twenty-two out of twenty-three persons employed, escaped unhurt before the explosion occurred.

Paper Barrels.—Among the numerous novel uses to which paper is now-a-days put is the manufacture of barrels for the carriage of such materials as flour, sugar, &c. These barrels are made of successive layers of paper board cemented together, and subjected to enormous pressure, the result of which is a compact substance with great resisting power. The paper is made of straw, thus fitting and converting into a merchantable article what, in most sections of the country, is regarded as refuse. The barrels are perfectly cylindrical in form, which gives them an advantage of 25 per cent. in storage over wooden barrels. Their weight is about half that of a wooden barrel, so that in a cartload a saving of nearly 1,000lb. in freight is made. It is calculated that they will stand four times the pressure that a wooden barrel will. The invention was patented a few months ago, and two factories are now engaged in the manufacture—one at Winona, Wis., and one at Decorah, Iowa. At the latter factory 1,600 barrels per day are turned out, with a consumption of five tons of paper. It is claimed for them that they can be made 20 per cent. cheaper than wooden barrels. They may be rendered absolutely air-tight, and it is claimed that they will resist moisture longer than they are likely ever to be exposed to it. They are made in quarter, half, and full sizes.

A Caution to Smokers.—It appears, according to the *Scientific American*, that even the cigars manufactured in Havana are now composed by no means entirely of tobacco, but to a considerable extent of "a kind of brown straw wrapping paper," prepared specially for this purpose in New York. Sheets of this material are saturated with the juice pressed from tobacco stems and are then passed through a sort of printing machine, which gives them the exact appearance of tobacco leaves; so much so, indeed, that the paper thus prepared is largely used for the "wrappers," or outer coverings of cigars, and is, in fact, said to be regarded by the makers as "an improvement on the natural tobacco leaf," inasmuch as it is "much stronger, more economical, and easier of manipulation." In

view of a further expression of manufacturing opinion to the effect that this "tobacco-flavoured straw paper also makes a filling for cigars superior to the genuine leaf, impossible to detect, and leaves a nearly white ash, just like that of the best quality of tobacco," some surprise may, perhaps, be felt that the cigar-makers in Havana think it worth their while to use any tobacco at all in the production of their wares; but it may be so far re-assuring to learn that, after all, "the delicate films of paper are interlapped with broken leaves of real tobacco." However, the quantity of this prepared straw paper imported into Havana is asserted to be very considerable. It is said that no Havana steamer leaves New York without taking quantities of it, the amount on each occasion varying from 5,000 to 30,000 reams.

Rapid Tanning.—A patent has been recently taken out in France for accelerating the process of tanning leather by passing an electric current through the solution of tannin while the skins are in the vats. The bottom of the vat forms one of the poles, and the other pole is placed on the surface of the liquid; by electric action a "molecular transportation" of the tannin ensues, which thereby passes through the skins and penetrates them more rapidly than in the usual method. It is said that heavy skins may be tanned by this process in from thirty to thirty-five days, instead of from twelve to fifteen months.

Utilising Coal Dust.—The problem of the utilisation of coal dust seems to be in a fair way of solution. The trouble has always been that it would not burn because it was too compact, and would smother rather than ignite. For fifty years that has been the one great impediment, and scientists could not overcome it. Finally, however, Superintendent Wotton, of the Reading Railroad, thought of introducing a steam blast through the coal from the bottom in the hope of penetrating the mass and supplying plenty of air. He built a furnace specially for it and placed it under a stationary engine boiler. Instead of using grate bars he employed a perforated iron plate for the fire to rest upon. A pipe from the boiler conveyed the steam and the necessary pressure supplied the blast, and this stroke proved to be the key-note of the entire coal-dust problem. It burned freely and threw out an immense heat. The oldest dust was used to see if it possessed burning qualities, and it was found that it consumed freely the same as the best coal. It was next tried in the furnace of a locomotive engine, and was found to burn equally well. The other day, when the wind was blowing at a velocity of forty miles an hour, a coal dust burning engine took up a train of one hundred cars through the valley with the same ease and with as little labour as an engine burning the very best anthracite coal. This is regarded as a great revolution in the coal and iron country, because it transforms at least 1,000,000 tons of heretofore useless coal dust into a fuel worth at the very least one dollar per ton, and provides a way to consume all coal dust that may come to the surface in the future.—*Harrisburg Chronicle.*

The Largest of the Krupp Guns.—The largest of the Krupp guns exhibited at Philadelphia has a calibre of $1\frac{1}{6}$ ft.; it is $26\frac{1}{4}$ ft. long, the bore extending $22\frac{1}{2}$ feet; the weight is 126,750 lbs. The bore has 80 parallel grooves, with a uniform twist of twice the whole length of the gun; it follows, of course, that the grooves do not make quite half a turn. To load the gun for a steel or chilled iron shell, 275 lbs. of powder are required; the shell itself weighs over 1,150 lbs. The whole machine—gun, carriage, and slide—weighs over 200,000 lbs.

Furnace Wool or Silicate Cotton.—The utilization of blast-furnace slag has for many years past occupied the attention alike of iron masters and inventors, but, although this waste product has to some extent been applied to economic purposes, the enormous slag deposits in the iron districts still continue for the most part to increase. Processes for converting this refractory material into sand, and subsequently into bricks, mortar, concrete, and cement, are being employed on a practical scale both in England and on the continent. In Belgium it is likewise used in the manufacture of glass, contracts being entered into with the proprietors of blast-furnaces for a regular supply. Another more recent and more singular application of this dense and brittle substance is that of a clothing for steam boilers and steam pipes, in order to prevent radiation and consequent loss of heat. To produce the slag in a proper condition for this purpose a blast of steam, water, or air is forced into the stream of viscous slag as it is run from the furnace. This peculiar treatment imparts to the slag a finely-divided character, and it assumes a fibrous form and appearance, somewhat similar to that of spun-glass. This fibrous slag is a bad conductor of heat, and has been used with success on the Continent for several years past for the purposes last indicated, being there known as "furnace wool."

Herr Krupp, of Essen, long since directed his attention to its production, and for the last three years the boilers and steam pipes at his extensive steel works have been clothed with this substance, to which he has given the name of "silicate cotton." Herr Krupp has also supplied this material to some of the largest manufacturing establishments in Europe, where it has been adopted with perfectly satisfactory results. Having thus successfully applied it, and having found it to be a very convenient way for utilising the slag from his blast furnaces, Herr Krupp has now arranged for its introduction into England. The special features of the silicate cotton are stated by Herr Krupp to be perfect incombustibility, even in immediate contact with fire, combined with comparative indestructibility, inasmuch as it is neither affected by damp, hot or cold water, acids, or any chemical ingredients, to which it stands in about the same relative position as glass. It therefore presents several advantages over the ordinary boiler coatings, and is besides capable of extensive application in the arts and manufactures. It is very light, a ton covering 560 square feet, even when applied 2½ inches thick, and, being of a woolly nature, it at once discloses a leak in steam boilers. Being a perfect insulator of both heat and cold, its application to fireproof structures, refrigerating apparatus, and the like, at once suggests itself. In short, this new introduction promises to subserve many useful purposes.

XXII.—PHOTOGRAPHY.

Fraud and Photography.—It has recently been affirmed by Göppert (*Papierzeitung*), that, no matter how carefully writing has been obliterated, sufficient traces of the iron oxide of the ink will remain to appear in a photograph of the piece of paper. The light reflected from the unwritten paper acts differently on photographic materials from that reflected from parts which have formerly been covered with ink, even though they may not be able to detect any difference. M. Göppert considers that the genuineness or falsification of a document may be always thus demonstrated.

Maps on a Small Scale.—It will be remembered that during the siege of Paris a good deal was done in the sending of photographically-reduced despatches by balloons. The inventor of the method of reduction, M. Dagron, has lately applied it to the production of maps. In this way, the whole official map of France is brought into a form that can be easily carried in a pocket-book; and maps of all the countries of Europe are arranged to be carried on a cartridge-belt along with the magnifying apparatus (*telemetre micrographique*), a joint invention of Dagron, Dallemagne, and Riboulet. The reduction of the maps can be on any required scale; the smaller this is, the more convenient the magnification. The telemetre has the size and form of a stereoscopic apparatus. By means of it all the details of the original map are greatly enlarged, and can be easily studied. In darkness, the light of a match, or even the glowing of a cigar, suffices to enable one to read off the map at once. The French anticipate these maps will prove very serviceable in case of war, as also for educational purposes.—*World of Science.*

Elastic Dammar Varnish for Photographs, &c. — An elastic flexible varnish for paper, which may be applied without previously sizing the article, may be prepared as follows:—Crush transparent and clear pieces of dammar into small grains; introduce a convenient quantity—say forty grains—into a flask, pour on it about six ounces of acetone, and expose the whole to a moderate temperature for about two weeks, frequently shaking. At the end of this time pour off the clear saturated solution of dammar in acetone, and add, to every four parts of varnish, three parts of rather dense collodion; the two solutions are mixed by agitation, the resulting liquid allowed to settle, and preserved in well-closed phials. This varnish is applied by means of a soft, beaver-hair pencil, in vertical lines. At the first application it will appear as if the surface of the paper were covered with a thin white skin. As soon, however, as the varnish has become dry it will present a clear shining surface. It should be applied in two or three layers. This varnish retains its gloss under all conditions of weather, and remains elastic; the latter quality adapts it especially to topographical crayon drawings and maps, as well as to photographs.—*Pharmazeutisches Centralhalle.*

Spiritualist Photography.—At a recent meeting of the Berlin Photographic Society a communication from Dr. Stein was read, in which he stated that he had recently met at a spiritualistic congress, the notorious Parisian spirit photograph-

ers, Buguet and Leymarie, and although he exposed them then and there, by taking similar photographs, he failed to convince the audience. Dr. Stein had a negative in his pocket, which he copied by the light of a candle, in the dark room, before developing the portrait of the gentleman who appeared with a female "spirit" at his side.

Photographing Machinery.—The use which manufacturers make of photography is shown by the circumstance that some of our larger firms retain the services of a photographer, whilst others have so much work to do that a studio and photographer form portion of their establishment. For some time past Krupp, the well-known cannon manufacturer at Essen, has availed himself of photography to a large extent, and has, indeed, gone so far as to adopt the Lichtdruck process, for the number of copies frequently required of one plate or another is so large, that their production would necessitate a long time if printed in silver. In securing records of models, or of finished work, before it is sent out of the workshops, photography is found to be extremely useful, and such firms as Penn and Sons, of Greenwich, Sir Joseph Whitworth and Co., and Sir W. Armstrong and Co., of the Elswick Ordnance Works, employ the art frequently in this connection. Photographing machinery is by no means an easy matter to the beginner, for it is difficult at one and the same time to show intricate mechanism on the under side of a machine, while the high lights are not solarised. The hand mirror is sometimes very skillfully made use of in work of this kind.—*Photographic News.*

Proto-stereotypy.—A sheet of ordinary plate-glass, larger than the picture to be reproduced, is coated in the dark room with a solution made by dissolving 1 ounce of potassium bichromate in 15 ounces of water, warming gradually, then adding 2 ounces of fine gelatine, and filtering through linen at the boiling heat. A diapositive is taken from an ordinary negative, and laid with the collodion side to the gelatine face of the prepared plate in diffused light for ten to thirty minutes. The plate is then taken from the frame in the dark room and washed with water for five or ten minutes, till the relief is fully developed, after which it is dried with filtered paper and coated with glycerine by means of a camel's-hair pencil, and the excess of liquid is removed with filter-paper. From this plate a cast is made in plaster of Paris of the consistency of oil, and from the plaster cast a metal one may be taken.

New Discovery in Photography.—A curious statement has appeared in some of our scientific journals regarding a case of small-pox which was discovered by photography. A person, feeling indisposed at the time, but not seriously unwell, attended at a studio to have a portrait taken, and the photograph of the face showed it covered with distinct marks, none of which, curiously enough, were apparent upon the sitter. A day or two afterwards, however, we are told, small-pox spots broke out all over the face, where they had been foretold by the camera. The explanation of the matter is simple enough, for the photographic lens often gives us impressions of objects invisible to the eye, while we, again, see things of which photography takes no notice. Another case is mentioned of a photographer who had, as a sitter, a lady with a bluish eruption on her face, and this he prophesied would be scarcely visible in the picture, as blue and white act pretty well in the same way upon the photographic film. He turned out right in his prognostications, but strange to say, spots appeared on the other side of the face in the picture, of which

there was no trace visible to the naked eye until a few days afterwards. We may, therefore, be able to use photography one of these days as an aid to forming a diagnosis, and we shall have physicians, may be, applying the camera to their patients as frequently as they do the stethoscope.

Vanadium as a Photographic Agent. — A sheet of paper, passed through a solution of a salt of vanadium, and exposed to sunlight, yields a well-defined picture on treating with salts of uranium. A compound of vanadium and silver, treated in the same manner, gives with ferrous sulphate a clear picture. Potassium bivanadate in contact with organic matter turns green and then blue on exposure to sunlight. These and other experiments prove that the scarcity alone of this metal prevents its being applied to the purposes of photography.

Fargier's Carbon Process.— According to the *Moniteur de la Photographie*, Fargier's new carbon process may be summed up in a few words. A sheet of paper is allowed to float upon a solution of five grammes of chloride of iron and a similar amount of citric acid, which are dissolved in one hundred grammes of water. This paper is afterwards dried in the dark, and placed under a negative to print, until a weak image is produced. This print is taken and floated upon a bath of coloured gelatine solution, when it is found that the gelatine attaches itself to the portions of the surface that have been acted upon by light. There remains nothing but to wash the sheet in water, and the picture is finished. If, instead of a coloured solution of gelatine in water, softened tissue were employed, the printed chloride of iron paper being pressed into contact with the same, warm water being used subsequently to separate the two surfaces again, there would perhaps be a step further gained in the simplification of the carbon process, for the pictures would be visible at once during the printing operation, and could therefore be controlled. Dr. Liesegang, writing in the *Archiv*, is of opinion that an improvement in the carbon process may be effected in this direction, and that the Fargier method indicates a branch of the subject which might be investigated with advantage.—*Photographic News*.

Protecting Photo Baths.— A rather ingenious idea appears in one of our German contemporaries, which, no doubt, is found to answer its object very well. It is a plan for preventing the dipping bath from being broken, which is a very vexatious thing, indeed, when it does occur, and in the case of travelling apparatus the circumstance is unfortunately rather rife. To reduce the occurrence to one of greater rarity, it is recommended that a buffer of paraffin be put between the bath and the case, which has the effect of protecting the thinnest utensil. Solid paraffin is melted and poured in the wooden case; then the glass bath itself is carefully and gradually heated by means of hot water, or otherwise, and pressed down into the molten paraffin gently. In this way the bath is made to fit with solidity in its wooden case, and will withstand the strongest pressure that is put upon it with the screw-top.—*Ibid.*

Etching Photographs on Glass. — The etching of photographs on glass is a process little practised by photographers, and yet some pretty applications may be made by ornamenting globes, vases, and drinking glasses in this manner. Some glass is better adapted for the purpose than others, and that which contains a good deal of lead is said to be the most suitable. Any photographic film is sufficiently thick for protecting the glass where the etching liquid is not to act, and

designs or pictures may therefore easily be formed capable of resisting the action of hydrofluoric acid, which dissolves the rest of the surface.

Extreme care must be taken in handling this acid, however; it must be kept in guttapercha utensils, for naturally enough, it will dissolve any vessel made of glass. Care should be taken also to prevent it touching the fingers, as it renders the hands very painful wherever it comes in contact with the flesh.

Glass faced with a surface of colour or opal may be worked with great ease, and the acid coming in contact with the unprotected surface dissolves away the facing, and leaves either a design in transparent glass, or one in colour, according as a negative or positive has been made use of to produce the mask upon the glass. A dilute acid is employed for etching in preference to a strong one, and the time that is required to dissolve away the surface depends in great measure upon the character of the glass itself. A carbon film will suit very well as a mask, and in this case it is well to apply the most solarised tissue to the glass surface, and develop the image upon the glass.

The image, under these circumstances, holds very tenaciously to the glass surface (which has not been waxed, it must be remembered), and, when dry, the glass object is transferred to the etching bath, where, if it happens to be a lamp globe, it is kept slowly revolving. The etching-bath is made of gutta-percha, or wood protected with sheet lead, and the object remains herein until the etching has proceeded far enough. When this is the case, the glass is withdrawn, washed, and then the carbon or other image removed in any ready manner that may suggest itself.

In the case of designs or lithographs which it is desired to etch upon glass, a special ink is employed, which is applied to the surfaces to be protected from the action of the acid. This ink is a thick solution of asphalte in turpentine, thickened by means of bees' wax and resin. In this case, as also in the case of photographs to be reproduced in ground glass or colours, it is necessary that the glass surface to be etched should, in the first place, be of ground glass or faced with coloured glass, blue, red, green, violet, &c., according to desire.

The lithographic ink or photographic film forming the design then protects the coloured or ground glass, and, the rest of the surface being washed away until the transparent glass underneath comes into view, there results a coloured or ground glass design upon transparent glass.—*Ibid.*

XXIII—LOCOMOTION.

Wealth in Steam-Engines.—According to a French journal, the number of locomotives at present in use in the old and new worlds amounts to 50,000, representing a money-value of 2½ milliard francs. In this number the United States figures with 14,200, England with 10,900, Germany with 5,900, France with 4,900, Russia with 2,600, Austria with 2,400, Hungary with 500, and Italy with 1,200 engines.

Rapid Railway Travelling.—The *Engineer* says that the following are the highest authentic instances of high railway speeds with which we are acquainted:—"Brunel, with the Courier class of locomotive, ran 13 miles in 10 minutes, equal to 78·miles an hour. Mr. Patrick Stirling, of the Great Northern, took, two years back, 16 carriages 15 miles in 12 minutes, equal to 75 miles an hour. The Great Britain, Lord of the Isles, and Iron Duke, broad gauge engines on the Great Western Railway, have each run with four or five carriages from Paddington to Didcot in 47½ minutes, equal to 66 miles an hour, or an extreme running speed of 72 miles an hour; the new Midland coupled express engines running in the usual course have been timed 68, 70, and 72 miles an hour. The 10 a.m. express on the Great Northern, from Leeds, we have ourselves timed, and found to be running mile after mile at the rate of a mile in 52 seconds, or at 69·2 miles an hour. The engines used were Mr. Stirling's outside cylinder bogie express engines, the load being 10 carriages." We imagine that all these speeds are at the "rate" of so many miles an hour, for it is certain that such speeds are never kept up.

Varied Colours for Railway Classes. — The Lancashire and Yorkshire Railway Company have resolved to adopt a plan which will be of great convenience to travellers. In place of having all their carriages alike, they will be painted different colours, according to the several classes, thus:—First class will be yellow, second brown, and third blue; and the tickets will correspond in colour, so that passengers, either at a terminus or when having stopped for refreshment, will have a good visible guide to their respective carriages. Composite carriages will be treated in the same way, and a sample carriage which has been turned out from the works at Southport has a most novel appearance.

Remedies for Railway Ills.—The *Field* gives the following seven points for remedying the defects of railway travelling, which, our contemporary thinks, if attended to, will, to a considerable extent, mitigate the severity of the annual butcher's bill upon our English railroads:—1. First and foremost, the adoption of the "block" system, in its most rigorous form, should be made compulsory. 2. Greater brake power should be compulsory. 3. Double couplings should be compulsory for all carriages and trucks when travelling from one station to another, even if the use of single couplings, to save time, should be allowed during shunting operations. 4. Footboards should be continuous, and made so as to overlap platforms. 5. Locking of carriage doors on both sides should be prohibited at any moment, even when a train is stationary; and when it is in motion both doors should be unlocked. 6. The consecutive hours of duty for

signalmen should be limited to six, and the maximum for one day at such a post, even with an interlude, should be ten. 7. Telegraphic communication (whether automatic or worked by human beings at both ends) should be enforced between signal and signal-box, else the signalman has no guarantee that his signal has obeyed his orders.

Stopping a Train.—In some recent high-speed brake trials it was found that at a speed of about fifty miles, with the most approved devices, and the employment of all available means of stoppage, including the reversing of the engine, a train cannot be stopped within a shorter distance than half a mile.

A New Fog Signal.—Mr. D. A. Aird (a member of the Bar), has just invented and patented a simple and useful process for the prevention of collisions on railways in foggy or snowy weather, when the ordinary day semaphores and night-lamps are indistinguishable. Without entering into technical details, of interest only to the scientific reader, it will be sufficient to state that by means of a lever, worked from a signal-box, a fog-signal is pushed on the side of the metal rail, which explodes by the pressure of a spring, touched by the flange of the engine-wheel, and by another movement a fresh signal takes the place of the old. The ordinary fog signal is placed on the surface of the rail, and although some provision is made for fixing it there, it is frequently knocked off. Mr. Aird's signal can never be displaced, can be renewed in an instant without any assistance from the hand, and, being stored in a small box of cast-iron, is impervious to rain or snow. It is not generally known that many engine-drivers are what is termed "colour blind," and cannot always be depended upon to distinguish the difference between the colours of lights and flags. If to every one the rule of the road was always plain and distinct there would be fewer accidents. "White for right and red for wrong, and green for gently going along," is the rule of the road by rail, but in a dense fog or in a blinding snow storm it is extremely difficult to tell whether the arm of the semaphore be white or red, or whether the signal light be white, red, or green. Mr. Aird's invention removes all possibility of doubt, and had it been in use on the Great Northern Railway on the night of the 21st of December, 1875, the deplorable accident at Abbots Ripton could not have occurred.

One-rail Railways.—While the war of the gauges goes on, a road has been commenced in California that is clearly out of the controversy, for it has no gauge at all. In other words it is to be an experiment with the one rail, or prismoidal, system, to connect the town of Sonoma with a steamboat landing. If it proves successful, it may turn out that this peculiar plan will meet with considerable use for local roads, and especially where expensive engineering would be necessary for the ordinary road. —*English Mechanic.*

An Electric Block Signal.—One of the most recently devised railway safety appliances is the electric block signal of Messrs. Saxby and Farmer, now working on the Brighton Company's main line at Croydon, after having been inspected and approved by Captain Tyler on behalf of the Board of Trade. By the use of this appliance, a signalman who receives a telegraphic indication of a line blocked from the signalman in advance, cannot possibly give a contrary signal upon the outside semaphore to the engine-driver, and so long as the signalman in advance wills he can maintain the semaphore signal at the "danger" position. In other words, the visible semaphore is under the control of both the signal-

men at each end of the block section, irrespective of distance. The safety signal can be given to the engine-driver only by the concurrent action and consent of both signalmen; while in any case of sudden emergency, the signal, if already indicating "safety," can be instantaneously changed to the "danger" position by either man independently of the other.

A Road-Indicator for Railways.—An apparatus has been attached to the rear of the pay-car used on the middle division of the Pennsylvania Railroad, which is expected to be of important service to the officers of the road when on tours of inspection. A roll of white paper 700 feet in length encircles a cylinder, from which it is payed out at the rate of three feet to the mile run by the car, its forward movement being regulated by the revolutions of the nearest axle under the car. A lead pencil, placed about the centre of the paper, indicates by its mark the condition of the track. The more uneven the track the longer will be the mark which the pencil will make. Another way of showing the inspecting parties that the track is uneven is by a horizontal piece of iron or steel, which oscillates like the pendulum of a clock, as the train moves. When a very defective point is reached, the pendulum comes in contact with a metal on each side, circular in shape, and creates a sound like that of a bell. This new invention is expected to work much more satisfactorily than the telegraphic apparatus formerly in operation.

Locomotive Statistics.—The number of locomotives owned by and at work on some of the chief English railways is as under—London and North-Western Railway, 2,019; North-Eastern, 1,331; Midland, 1,196; Lancashire and Yorkshire, 670; Great Northern, 533; Manchester, Sheffield, &c., 374; London and South-Western, 363; London, Brighton, and South Coast, 270; South-Eastern, 255; London, Chatham, and Dover, 142; North Staffordshire, 118; North London, 66; South Devon, 54; Metropolitan, 44; Metropolitan District, 24; Cornwall, 21.

The Railways of the World.—In a recent issue of one of the German railway journals, Dr. Stürmer gives the following table, in which the existing railway systems are compared together, according to the most recent data up to at least the end of 1874. The last column contains the mean proportional (*i.e.*, the square root of the product) of the numbers contained in the two previous columns. The numbers of this column show in what relation the different railway systems stand to each other, with reference both to extent of country and population:—

1. Europe.

	Length of Railway	Length of Rail. per sq. mile	Length of Rail. per 10,000 in	Mean proportio
	Kilo.	Kilo.	Kilo.	Kilo.
Belgium	3,479	6·50	6·62	6·56
Great Britain	26,870	4·69	7·86	6·07
Switzerland	2,080	2·76	7·79	4·64
Germany	27,956	2·84	6·80	4·40
Netherlands, including Luxemburg	1,895	2·94	4·78	3·75
France	21,587	2·25	5·98	3·67
Denmark	1,260	1·81	6·72	3·49
Austro-Hungary	17,368	1·53	4·73	2·60
Sweden	3,967	0·53	9·14	2·21
Italy	7,688	1·42	2·87	2·02
Spain	5,796	0·64	3·56	1·51
Roumania	1,233	0·56	2·73	1·23
Portugal	1,033	0·61	2·35	1·20
Russia	18,547	0·19	2·52	0·69
Turkey	1,537	0·23	1·83	0·65
Norway	499	0·09	2·78	0·48
Greece	12	0·013	0·082	0·033

2. Asia.

Caucasus	1,004	0·12	2·05	0·51
India	10,443	0·24	0·51	0·36
Ceylon	132	0·11	0·55	0·25
Java	261	0·10	0·14	0·12
Asia Minor	401	0·011	0·30	0·059
Japan	61	0·011	0·018	0·014

	Length of Railway.	Length of Rail. per sq. mile.	Length of Rail. per 10,000 in.	Mean proportion.
3. Africa.				
	Kilo.	Kilo.	Kilo.	Kilo.
Mauritius	106	3·05	3·34	3·19
Algiers	537	0·044	2·50	0·33
Egypt	1,528	0·037	0·90	0·18
The Cape	108	0·010	1·50	0·12
Tunis	60	0·028	0·30	0·091
4. America.				
United States	119,824	0·86	31·07	5·17
Canada	6,609	0·24	18·19	2·10
Cuba	640	0·29	4·57	1·16
Chili	991	0·16	4·79	0·87
Uruguay	305	0·093	6·77	0·79
Peru	1,549	0·053	6·19	0·57
Argentina	1,584	0·027	8·44	0·48
Panama	76	0·060	3·45	0·45
Jamaica	43	0·21	0·85	0·43
Costa Rica	47	0·046	2·45	0·34
Honduras	90	0·040	2·56	0·32
British Guyana	96	0·023	4·46	0·32
Paraguay	72	0·027	3·26	0·29
Bolivar	30	0·023	1·71	0·20
Brazil	1,338	0·008	1·37	0·11
Mexico	607	0·017	0·65	0·10
Venezuela	13	0·001	0·09	0·01
5. Australia.				
Victoria	906	0·21	12·05	1·62
New Zealand	383	0·076	13·03	0·99
New South Wales	657	0·045	12·35	0·74
Queensland	423	0·013	35·26	0·69
Tasmania	72	0·058	7·27	0·65
South Australia	316	0·017	16·45	0·53
West Australia	64	0·0014	25·60	0·19
Tahiti	4	0·19	2·90	0·74

Taking the separate continents, the following numbers represent the entire lengths of railway (in kilometres), in 1875, as compared with previous years:—

	1860.	1865.	1870.	1875.
Europe	51,544	75,149	103,744	142,807
Asia	1,397	5,568	8,132	12,302
Africa	446	837	1,773	2,279
America	53,235	62,735	96,398	133,914
Australia	264	825	1,812	2,820
Total	106,886	145,114	221,859	294,122

Thus we see that the length of all railways within the last 15 years has increased nearly three-fold, and in the last 10 years has more than doubled.

Five Hundred and Forty Miles away.—A correspondent telegraphed to the *Times* from Aberdeen in the beginning of July:—"At a distance of 540 miles we are for the first time enabled to read the *Times* and other metropolitan papers on the evening of publication. This has been accomplished by the accelerated services of the East Coast companies. Copies of the *Times* have been sent to the Lord Provost and others in celebration of the event."

The Highest Speeds of Railway-trains.—The "Flying Dutchman" is without doubt, for a comparatively short distance, the fastest train in the world. It runs from London to Swindon, seventy-seven miles, in eighty-seven minutes, being at the rate of fifty-three miles an hour, while Exeter, 193¾ miles, is reached in 4¼ hours, giving an average pace of 45½ miles per hour. Next to this train for speed is the run by the Great Northern Railway to Peterborough, when the average rate is fifty-one miles, while the 272 miles to Newcastle is travelled in six hours and twenty minutes, or at forty-three miles an hour. The limited mails of the London and North-Western, while running to Edinburgh northward, and Holyhead westward, have trains travelling the 401 and 264 miles respectively at a pace of forty miles an hour. The Midland conveys its passengers to Leicester, 97½ miles, in one hour and 37½ minutes, the pace being 44¾ miles. The London and Brighton, by their fast trains, run to "London-by-the-Sea" in an hour and ten minutes, the rate being forty-three miles an hour; and the South-Eastern takes Channel passengers to Dover at forty-one miles an hour.

On the Continent we do not find anywhere such pace as we have just mentioned. The French express from Calais to Paris is the fastest French train, doing thirty-seven miles an hour on an average, while from Paris to Marseilles, a distance

of 537 miles, travellers are conveyed in 15¾ hours, or at a rate of thirty-four miles an hour. Swiss railways are extremely slow, expresses only attaining a speed of twenty-two miles an hour. In Belgium, the highest speed is thirty-three miles an hour, and in Holland 33½ miles. From Berlin to St. Petersburg, 1028 miles, is traversed in forty-six hours, the pace being 22½ miles an hour.

Turning to America, the "lightning train," as it was called, recently passed from New York to San Francisco in eighty-four hours, or at an average pace of forty miles, but during a considerable portion of the journey, fifty miles an hour was run in several consecutive hours. This train, however, is the exception that may be said to prove the rule, as American trains on an average run very slowly, as, for example, on the Intercolonial Railway 20½ miles an hour is the ordinary pace, and from Buffalo to Stratford thirty-three miles is the greatest speed.

"Roughing" Horses.— With regard to "roughing" horses in frosty weather, Mr. Fleming, of the Royal Engineers, has tried a plan suggested to him from Russia, which he strongly recommends, and which is free from the objection of great expense. It consists, says the *Sanitary Record*, simply of punching a square hole in each heel of the shoe, which in ordinary weather may be kept closed by a piece of cork. In frost the cork is removed, and a steel spike inserted. If this steel "rough" be made to fit the hole exactly, it remains firm in its place, and is not liable to break off short at the neck like some of the screwed spikes. The economy of this method consists in its saving the expense of the screw. Putting a "thread" into the holes of the shoe and into the spikes, is a tedious process, occupying much time, and therefore is costly. If Mr. Fleming's suggestion were widely adopted, the square steel spikes could be supplied at a very low figure, as machinery could be made to turn out three or four different sizes, each of uniform gauge, and the farriers could punch the holes to fit them with great exactness. We commend this plan to the notice of the large horse-owning firms, believing that it only requires a trial to establish it as the best system of "roughing" extant.

Easy Work for Horses.—The German War Minister has lately caused experiments to be made with an apparatus devised by M. Fehrmann, and called a *Pferdeschoner* (literally, horse-sparer). It is meant to diminish the fatigue of horses in drawing vehicles, as also the chances of rupture of the shaft or traces. It consists of a number of indiarubber rings, separated from each other by iron rundles; the whole is contained in a cylindrical metallic case, and a metallic rod, fixed to the last rundle, and traversing the case, is a means of compressing the caoutchouc rings. The length of the system is 0·30m. Two are required for each horse. They are interposed between the traces and the trace-hooks, thus forming an elastic pad between the horse and the weight to be drawn. In commencing to pull, horses do not make a gradually increasing effort, but generally precipitate themselves on their traces with a sudden shock, wasting their strength, and probably doing injury. Fehrmann's apparatus remedies this by the gradual compression of the caoutchouc rings. The initial effort required of the horse is less, and then it progressively increases. The experiments showed this initial effort to be only 0·83 of that necessary without the apparatus; the mean effort of traction 0.82 of that without the appa-

ratus; while the variations of this effort in the one case were only 0·66 of the oscillations which occurred in the other. These numbers refer to a walking pace; with trotting, they become respectively 0·59, 0·80, and 0·78. The price of the apparatus is about 15s.—*English Mechanic.*

American Views concerning Steam Carriages on Common Roads.—The very earliest attempts at locomotion were made upon common roads, and, so far as movement on these has been effected, the success attained nearly seventy years since by Trevithick has scarcely been equalled, and certainly has not been far surpassed down to the present time, notwithstanding the great advance in the knowledge of the properties of steam, and in the facilities for constructing engines. The essays have been numbered by the hundred. Experienced mechanics, with skilled labour applied in the direction of thorough knowledge of mechanism and of the steam-engine, have vied with inventive projectors who have possessed that ignorance which, untrammelled by educated notions to unlearn, sometimes gives scope to ingenuity and novelty; and both knowledge and invention have iled alike.

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The success of the "three-cylinder engines," now made by the thousand, almost, in England, and its peculiar facility for the use of the expansive force of steam at high velocities, seems to open a ray of light into the darkness where the steam carriage of the future now lies. The recognition of the fact that the interstices of a mass of coal, on a given surface, present an equal area for any size of lump, whether coarse (large) or fine, only that all the lumps or grains must be sorted to the same size, is slowly being made; and as our fine anthracite coal, of pea-size, runs like water, it follows that automatic firing of the small boiler will be the finality for the purpose of the steam-carriage, as well as the possible finality of the firing of marine, if not all, steam boilers. This, with suitable automatic arrangement for feeding, will permit the steam-carriage to be run by one man alone. Only some of the salient points of the mechanism of the coming carriage have been noticed here; others of nearly equal importance present themselves, which can be discussed or settled in the same way by those especially interested.

Eventually the steam-carriage will be as distinctive as the locomotive-engine, and will have its nationality as the locomotive has, and its individuality, as the American locomotive of to-day has Wm. Mason inscribed upon it.

The steam-carriage when in use on the public highways or tram tracks, will be much more safe from accident of any kind than the ordinary vehicle or the street car. The requirement of penalty can be made as stringent as, setting all statute laws out of the question, will allow the enforcement of common law; and, under the impulse of such penalties, automatic contrivances of all kinds—safeguards, catchers, detentors or arresters—will multiply to the point that will give security to the other traffic quite as great as that now attendant upon the average driver and the carriage horses, while the control of the apparatus, either to start or to stop, can be made certainly as effective as the present ordinary carriage, however carefully driven.

The abuse of horses in our street cars is a shocking evil, and those instincts of humanity which lead us to avoid the occasions or exhibitions of cruelty, now urge with great strength the substitution of inanimate force for so completely mechanical exertion of power. The repairs and restoration of the road-

ways, consequent upon the employment of horses in so large numbers, form the chief items of expense to the highway department, and the substitution of steam carriages would materially reduce this burden on the city. The removal of the horses from the street railroads alone, would greatly improve the cleanliness of streets, by the prevention of so much decomposable matter now deposited upon the surface of the pavement, to be ground under the wheels to an impalpable powder, blown about with the winds, and vitiating the very air we breathe. With due regard for the public health alone, it is desirable to substitute the steam carriage for the horse car.—*Franklin Institute Jour.*

A Self-Propelling Tram-Car.—This tram-car, invented by M. Mékarski, worked by heated and compressed air, has been tried with success on one of the Paris tramways. The framing is supported on two axles rather near together to facilitate the passage round curves; and the body, after the style of the Northern Tramway Company of Paris, contains seats for sixteen passengers, while standing room is afforded for fourteen more on the hind platform. In front is another platform, of smaller dimensions, reserved for the driver, and carrying the heat chamber and regulator, the use of which will be explained further on. Air-tight cylindrical reservoirs for the compressed air are connected together by copper pipes, and are divided into two series, the larger constituting the principal motive agency, and the smaller, of one third the volume, constituting the reserve. On leaving the reservoirs, the compressed air passes through a column of hot water, in which it becomes saturated with steam at a high temperature; this water, which is introduced before starting into the heating chamber at a temperature of 338° to 356° Fahrenheit, gradually parts with its heat during the journey, so that its temperature becomes reduced to about 212° to 248° Fahrenheit at the end of the course. In the upper part of the heating chamber, therefore, is contained a mixture of air and steam at the pressure of the reservoirs. Instead of discharging this gaseous mixture directly into the working cylinders at a pressure which is necessarily variable and continually decreasing, it is made to pass through a special appliance by which the pressure is regulated automatically to a given degree, variable at the will of the driver, notwithstanding the variations of pressure in the reservoirs. On leaving the regulator, the gaseous mixture enters the cylinders, where it acts upon pistons similar to those of a locomotive.

The distinguishing feature of M. Mékarski's system is the use of air saturated with steam, whereby a long run may be made with a comparatively small quantity of air. The action is noiseless, for the steam, instead of exhausting, is condensed in the cylinders as completely as possible, in order to restore to the air all the latent heat absorbed by the vaporization. The tram-car is so well under hand that it can be stopped suddenly, again started, and the speed increased or slackened with the greatest ease. At one end of the line, air-compressing machinery must be erected, with powerful expansion and condensing engines, working pumps for forcing the air, compressed to 25 or 30 atmospheres, into the reservoirs of the tram-cars while they are at rest, and the excess into fixed reservoirs; each car, after its double journey, receives its charge of air, while at the same time steam is introduced into the heating chamber to restore the amount of heat lost on the journey.—*Journal of the Society of Arts.*

Air as a Means of Propulsion.—At a meeting of the Royal Scottish Society of Arts, held in February, Mr. D. Scott Moncrieff, C.E., Glasgow, read a paper on "Stored Air as a Means of Propulsion." He gave a history of experiments on air as a motive power, and described by drawings the means of propulsion used in a tramway car invented by him and used in Glasgow, and of which he exhibited a model. He went on to say that he thought the medium which was the very means of our own life, and which we were breathing every moment, was one in regard to which, on sundry grounds, there could be no objection whatever. The air, when forced into a mechanical appliance, performed its work, and when it came out it was as pure as when it went in. The cost of propelling an engine weighing from eight to ten tons was a penny per mile, and he was sure that with a proper engine the cost might be reduced to one halfpenny per mile. There was no doubt that cars constructed on the principle of propulsion by compressed air could be constructed much more cheaply than if steam were employed. The total weight of air required for running about four miles was 160 lbs., which was not so heavy as steam. The engines in the cars supplied with air were in a separate framing, so that when the engines required to be repaired the carriages could be removed without delay to another set of engines. The car in Glasgow had been running for the last eight months without any difficulty whatever. The vehicle had performed the journey he had expected, and he hoped that before long the poor tramway horses, which were to be commiserated, would be relieved of their heavy burdens.

Tricycle Velocipedes. — Mr. J. H. Walsh has obtained a patent for improvements in the combination and arrangement of the various parts of tricycle velocipedes, so as to dispense with the axletree, with the special object of bringing the centre of gravity when the rider is mounted in position as low as possible consistent with ease and freedom of motion and the full development and expenditure of power, so that the riding of such vehicles will be attended with more safety and comfort, and with less danger of injury to the machine. Motion is given to the forewheels direct by means of handles attached inside and to the spokes. By these improvements the body of the rider is supported between and below the axles of the wheels, and in such a position as to enable him to guide and propel the machine with great ease and with complete utilisation of all attainable power, the fore wheels with his hands, and the hind wheel with his feet.

Velocipedes Moved by Steam.—A Berlin mechanician has invented a steam velocipede, which is said to answer admirably. The engine is heated with petroleum, and, being placed on the two back wheels, does not interfere with the convenience of the driver.

For Fast Walkers.—An inventor has obtained a patent for a method of "enabling persons to travel on foot with increased speed." The invention consists of a plate of iron cut to the form of the heel and sole of the boot and attached thereto, which plate is provided with two springs, upon which the person treads, and is "thereby," says the inventor, enabled to walk with increased speed and ease.

A New Danger.—Sir John Hawkshaw has sounded the following note of warning:—"Probably few persons are sufficiently aware of the danger to life and limb those who have to frequent the streets of London incur from the telegraph wires which every day are being

suspended high above our heads. Galvanised wire in a smoky atmosphere does not last more than about twelve years, and the first intimation of decay, in all probability, will be the falling of the wires upon the passers-by; and the weight of the wires, and the height from which they will fall, will be generally sufficient to kill or maim those upon whom they fall. I don't know who will be responsible for the consequences, but it is advisable for those that will be, to pay some attention to the subject. If the suspension of these wires over the most crowded thoroughfares be a necessity, they might be directed with more regard to safety by being made, for instance, to cross at right angles, instead of running obliquely over the whole length of some streets—a method that seems well adapted, when they fall, to do the greatest mischief to the greatest number."

A Signalling System for Mariners.—Sir William Thomson read a paper before the British Association on "Naval Signalling," in which he advocated the use on board ship of the fog signalling system, instead of the flag system now in use. His method is simply this—to signal according to the Morse telegraphic code, by means of two sounds of slightly different pitch. For the long signals he would take a grave note, and for the short signal a less grave note, or what he might call an acute and a grave note for the dot and the dash. Sir William Thomson then gave several signals to show the efficacy of the plan he proposed, and he maintained that the shortness of the time required to make flag signals was far less than could be attained by the phonetic method. Long before the signal flags could be hoisted, the order would be given and read by every ship, and repeated by the different ships in order, back to the admiral. Two sounds of different pitch made in rapid succession were all that was necessary, and to accomplish this a ship need but have two steam whistles, each with a different note.

A Life-saving Trunk.—This latest life-saving invention is of very moderate dimensions—six cubic feet per individual—the weight being about seventy pounds. It can be used to carry clothes, &c., for ordinary travelling purposes, and, in case of emergency, can be instantly converted into a lifeboat, of which it has the essential features; and it has been shown to possess an extraordinary degree of buoyancy. Two occupants can keep themselves dry and warm in the roughest sea, and carry with them provisions for a month. The trunk occupies only half the cubic space per individual of that of boats, and the inventor (Mr. W. R. Gade) believes it is destined in great measure to take their place as a means of saving life.

Fires on Board Ships.—A method of extinguishing fires on board ship has been submitted to the Russian Admiralty. Two receptacles hermetically sealed, and containing anhydrous bicarbonate of soda, are to be placed in the forecastle of the vessel, with two retorts containing sulphuric acid connected to them by a siphon, but closed by means of stop-cocks. In case of fire breaking out, the cocks are to be opened, when the mixture of the two substances will generate carbonic acid, to be led through pipes provided for the purpose into the hold, and thus extinguish the fire. The commission charged with examining into this method reported against it, on account of the danger to the crew in case of breakage or leakage of the tubes, and also the fact that carbonic acid being heavier than air, it would be difficult to free the vessel from it. The *Rivista Maritima* considers, however, that this plan might be adopted with ad-

vantage in the powder magazine and in portions of the vessel which are isolated from the rest: besides this, substances much more dangerous are stored on board vessels than carbonic acid, which might be the means of preventing an explosion and the loss of everything.

A New Log for Measuring the Speed of Ships. — Mr. Fleury, mechanical engineer, of Bristol, has invented and patented a new log for measuring the distance traversed by vessels at sea, whilst under either sail or steam. The instrument is a most ingenious piece of mechanism, and is to be fixed either in the engine-room or in the captain's lower cabin. The water is conveyed to it by means of Kingston valves, placed in the side of the vessel, and the impact of the water while the vessel is moving communicates motion to some clock-work, and the distance is recorded by means of a dial. There are four smaller dials within a large one, which record the knots by units, tens, hundreds, and thousands; while the large dial tells the statute miles, so that the measurement can be taken either in knots—which is far preferable to seamen—or by statute miles, and the total registration is from one to a million miles.

Circular Yacht. — A curious little circular sailing yacht, twenty feet in diameter, has been built by a young officer of the Russian Navy, to show that the circular form is not by any means so adverse to speed as many suppose. She is cutter-rigged, with a very taut mast, and has great speed under canvas in combination with an altogether unequalled power of staying and wearing. She is perfectly round, like a tea-saucer, and, having great stability, can carry, almost without inclination, all the canvas which it is possible to spread upon her. She is consequently very fast, and extremely handy withal.

Proposed Sea Signals.—Mr. J. J. Hall read a paper recently in the Royal United Service Institution, Whitehall, "On a Proposed Signalling Masthead Lamp." The author opened his discourse by stating that, with a view to securing greater safety to vessels, more especially those under steam, while travelling the great highway of nations by night, he had recently directed his attention to the "rule of the road by sea," and all that at present existed in the construction, arrangement, and use of starboard, port, and masthead lights, together with the conditions under which positions were approximately determined, and the laws by and under which freedom from collision was at present looked for. It must, he thought, be admitted that the present system was very imperfect, inasmuch as the judgment on the part of one or other, or both, of the officers in charge of opposing or crossing vessels was too much depended on. After describing the present system of steamship lighting, Mr. Hall went on to say that his object was neither to change the colour of the lights now in use, the respective positions at present assigned to them, nor the regulations depending thereon; but merely to make such additions in the case of one of them—the masthead light—as should be the means, in cases of immediate or probable danger, of setting all present doubt at rest. At very considerable length, then, the author of the paper, illustrating his suggestions by means of carefully-prepared diagrams, proceeded to explain the nature and working of his proposed signalling masthead lamp. His great desire was to introduce an auxiliary, by the help of which present uncertainty and doubt should be swept away, and security and confidence be established. In conclusion, he expressed a hope that, in time to come, the friendly signals of some such system as that proposed

by him might be the means of placing the mariner in possession of that confidence and assurance of which he was now so much in need.

Electric Lights at Sea.—One of the French transatlantic steamers has been fitted with electric light for signalling and illumination at sea. Her arrival in Plymouth Sound caused much sensation among seafaring men, her light shining with such brilliancy as to light up all other ships in the harbour and breakwater. An iron lighthouse is built in her bow, whence is shown a light so intense as to penetrate the thickest haze, and be visible for miles. The experiment has proved so successful that the company's other ships are to be similarly fitted.

A Ship for Arctic Seas.—Mr. Sewell proposes to carry the mails between Shediac, Nova Scotia, and Summerside, Prince Edward Island, during the winter by means of a new ice-ship; and should this vessel succeed in making regular passages through the heavy hummock ice, which is characteristic of the Straits between these points, it will go far to solve the larger problem. The following is a description of his vessel:—Length over all, 153ft.; breadth of beam, 26ft. 8 in.; depth of hold, 16ft. It has a considerable rise of floor; a peg-top split vertically would give a good idea of the form of its midship section. This form of hull secures the vessel from right-angle pressure, thus reducing the pressure of the ice to a minimum. The stem is well rounded at the lower part, so as to secure riding in heavy ice. The iron plating for the protection of the hull is composed of 700 bars of 4in. by ⅞in. flat iron, reaching from 2ft. above the load water-line to within 4ft. of the keel. The vessel is fitted with engines of 700-horse power. The screw propeller is 11ft. 6in. in diameter, with a pitch of 17ft., and will at all times have 3ft. of water above the blade as a protection against the ice.

Steel-wire Hawsers.—The *ew York Bulletin* states that Commodore Shufeldt has ordered the proper authorities of the Boston Navy-yard to make several steel-wire hawsers five inches in diameter. These will probably be the largest wire ropes ever made. The Navy Department use immense hawsers to tow monitors and vessels in distress. They are put on board the men-of-war for use when required. The usual appliance is a 12in. hemp rope, but it swells when wet, and gets very heavy by absorption of water. The steel-wire hawsers will be several inches less in circumference, much lighter, non-absorptive, more pliant and durable, and in every respect better. This is a curious and, in fact, wonderful advance in the application of steel and iron to commercial uses.

Collapsing Boats.—A successful trial was recently made in the sheltered part of Portsmouth harbour of an improved collapsing horseboat, designed and constructed by the Rev. Mr. Berthon, of Romsey. Mr. Berthon has introduced several improvements of construction, and from the manner in which the boat underwent a severe trial, it would appear as if the collapsing principle has been at length successfully applied.

An Old Ship.—The barque *True Love*, which recently discharged a cargo of ice from Norway at Kingston Dock, is one of the oldest craft afloat. She was built at Philadelphia, North America, in 1764, and is thus 113 years old, and has braved "the battle and the breeze" ever since. Her registered tonnage is 284, and her length from stem to stern is 96ft. 8in. Captain Joseph Velsey, the master, warrants her strong, staunch, and entire, notwithstanding her great antiquity. The builders of this remarkable

barque are unknown, their names having been lost in the intervening period. During the earlier career of the *True Love* she was one of the most successful whalers afloat.

The First Steamer to Cross the Atlantic.—The first steamer that crossed the Atlantic, says *Engineering*, was H.M.S. *Rhadamanthus*, which in April, 1833, was taken to Jamaica by Captain (now Admiral) George Evans. This date is five years before the voyage of the *Sirius*, and some months before that of the *Royal William*, for which latter vessel the honour of being the pioneer has only recently been claimed.

Help for Ships in Distress.—A series of experiments, organised by the Committee of the Maritime and Fluvial Exhibition, with a view of testing different life-saving apparatus, took place in October, 1875, on the Lac d'Enghien. The chief interest centered in a kind of competition between the rocket apparatus used by the English coastguard, under the direction of the Board of Trade, and the mortar designed, with a similar object, by Mr. Banting Rogers. A raft, supposed to represent a ship in distress, was moored out in the lake, and lines were thrown over this. Although the rocket apparatus was remarkably well handled by a picked contingent of coastguardsmen, under Captain Keith Prowse, R.N., the honours of the day were decidedly won by Mr. Rogers, whose projectiles have the great merit of carrying a double line, by means of which safe and continuous communication is at once established with the shore. Lord Lyons and several other distinguished persons were present.

A Great Gun for Foggy Weather.—A new fog-gun, the invention of Major Maitland, has been erected at the North Stack, Holyhead. It is a breech-loader, five inches in bore, the breech of which revolves like the head of a capstan, with holes for the insertion of bars. The five chambers are charged with cartridges, which can be fired in rapid succession. The gun has a bell-mouth, with a diameter of thirty-four inches—a sort of parabolic sound reflector—and the sound can be heard, so it is said, fifteen miles in foggy weather.

A Circular Vessel for Saving Life.—While the circular form is being applied with more or less success to the ships built for the destruction of men and the ruin of nations, it is also being applied to a vessel for saving life. The invention of Mr. J. A. Stockwell is a circular vessel, twenty-eight feet broad, and constructed of a ring five feet across, on the inside of which are fitted seats. The seats are made watertight, so as to carry fresh water and provisions. Over the annular cylinder there is a battened deck fitted by means of knees, so that the sea can break up through it and lessen the chance of capsising. This strange vessel is fitted with rudder and stem, masts, sails, and a drop keel, which can be lowered or raised at will. She is divided into four water-tight compartments by bulkheads with sluice-valves, each compartment having a separate hatchway, with ventilating cap constructed to admit air and keep out water. Each compartment has water-tight scuttle lights, and there is a pump for keeping her dry. Life-lines are fitted all round her, and it is almost impossible to overload her. The invention looks promising.

Improved Water Communication.—An invention made, or rather developed and strikingly perfected in Germany, allows of existing water communication being turned to the best account. It is not too much to say that the usefulness of some rivers and canals has been trebled since the introduction of the towage system. For ingenuity,

cheapness, and despatch combined, this mode of locomotion beats all others. Beautiful Dresden will have given many of your readers the picture I want to place before you. Imagine a heavy chain laid along the bottom of the river, and moo: at both ends. This chain, passed through the bows of a steamer, revolves round a drum worked by the engine, and is paid out at the stern. The effect of the arrangement is that, as the drum revolves, the vessel is propelled forward along the chain, like a man pulling himself up by a rope. Now, the adhesion of the chain to the bottom of the river being equal to 75 per cent. of its weight, no matter how heavy the ship and its cargo may be, it cannot lift the cable from its place. Thus, while the weight which can be moved onward in this simple manner is practically unlimited, the expense entailed is no more than the fuel consumed in working the drums.

Many a time when roaming about in the charming valleys skirting the Elbe, have I wondered at the extraordinary spectacle presented by these steamers. A tiny boat, without paddles or screw—in nothing a steamer, except the engine—moves along the chain with a rapidity not much inferior to that attained by the ordinary paddle-wheelers on the stream. Attached to this boat you see a perfect fleet of barges, each one as large again as their diminutive leader, and all heavily laden, with grain, stone, or some other ponderous cargo. As the small craft glides on her way, breasting the current without effort and dragging from ten to twenty vessels after her, the sight reminds one of a dwarf with the Tower of Babel on his back. Yet such are the draught powers of this naval pigmy, and so jauntily does he do his work, that he can afford to labour for next to nothing. Barges entrusted to his guidance perform any distance in about a third the time they could by sail or oar; and as the company charge at an average rate of only 1*d.* per mile for every 100 cwt. the skippers save two-thirds of the cost formerly incurred.

The impetus given to navigation by this profitable device is enormous. In 1873 the company towed between Magdeburg and Dresden alone, 10,000 barges, carrying about 3,000,000 cwt., and travelling an aggregate distance of 500,000 miles. As the friendly cable is laid down all the way from Hamburg to Magdeburg, Dresden, Schandau, and further on to the Bohemian frontier, the total figure of vessels towed must be something immense. The like beneficent machinery is in use on the Rhine, the Oder, &c., and is fast finding its way to other waters. Now that Northern Germany has got to the end of its firewood, and, in addition to indigenous peat and an inferior sort of coal, has to resort to the lignite of the Central Provinces, the advantages of the towage system cannot be too highly rated, even in the present scarcity of canals. If the cry for canals has been lately heard from so many points at once, this is partly owing to the incalculable benefit to be derived from them upon the universal adoption of the towage system. What has been already done enables us to anticipate the time when, unless the greatest possible speed is required, heavy goods will no longer be conveyed by rail.—*Times.*

Collisions at Sea.—M. Trève has submitted to the French Academy a new system of signaling, with the object of diminishing the frequency of collisions at sea. He proposes to employ a signal which will permit the officer of the watch, on perceiving a vessel at a short distance a-head, to make known to those on board of her the tack on which he intends to pass her, and that instantaneously. The method by which this is to be accomplished

consists in the use of a green or red fire ignited by electricity, the means of joining contact being close at hand. The green fire would show the helm is put to starboard, and the red that it is put to port. This is to avoid the danger of collisions through both vessels going on the same tack.—*Journal of the Society of Arts.*

A New Method of Sounding the depth of the Sea.—At the meeting of the Royal Society, held on February 24th, Mr. C. W. Siemens, F.R.S., exhibited an instrument he has devised to ascertain the depth of the sea without using a sounding line. He has worked out the requirements, starting with the proposition that the total gravitation of the earth as measured on its normal surface is composed of the separate attractions of all its parts, and that the attractive influence of each equal volume varies directly as its density and inversely as the square of its distance from the point of measurement.

It was in 1859 that Mr. Siemens first attempted to construct an instrument based on these principles. The difficulties he then encountered he has since overcome, and the present instrument is the result of his latest work. He proposes to call it a bathometer, and it consists essentially of a vertical column of mercury contained in a steel tube having cup-like extensions at both extremities, so as to increase the terminal area of the mercury. The lower cup is closed by means of a corrugated diaphragm of thin steel plate, and the weight of the column of mercury is balanced in the centre of the diaphragm by the elastic force derived from two carefully tempered spiral steel springs of the same length as the column of mercury. One of the peculiarities of this mechanical arrangement is that it is parathermal.

The instrument is suspended a short distance above its centre of gravity in a universal joint, in order to cause it to retain its vertical position, notwithstanding the motion of the vessel; and vertical oscillations of the mercury are almost entirely prevented by a local contraction of the mercury column to a very small orifice. The reading of the instrument is effected by means of electrical contact, which is established between the end of a micrometer-screw and the centre of the elastic diaphragm. The pitch of the screw and the divisions upon the rim are so proportioned that each division represents the diminution of gravity due to one fathom of depth. Variations in atmospheric pressure have no effect on the reading of the instrument, but corrections have to be made for latitude. The instrument has been actually tested in voyages across the Atlantic in the Faraday, and comparisons with Sir W. Thomson's steel wire sounding apparatus prove that it is trustworthy.

Such an instrument as this may prove of the greatest service to mariners, not only in saving time and trouble, but in assisting such interesting investigations as those carried out by the scientific staff on board the *Challenger*, and we therefore cannot but wish well to Mr. Siemens' very ingenious invention.

"Plate Swimming." — One evening in April, Mr. R. H. Wallace-Dunlop explained and illustrated to a meeting of his friends and of the public his new system of "Plate Swimming." Mr. Wallace-Dunlop is keenly alive to the need of a more general knowledge of swimming, especially among the army and navy; and even as an amusement he believes it could and should be made as easy and as pleasant as "rinking." He even dreams of a day when swimming may be practised in dress by both sexes with the same ease and freedom as they now enjoy skating, boating, croquet, and other

amusements. In his study of how this end is to be attained, Mr. Wallace-Dunlop has watched the habits of animals in natation, and has thereby had suggested to him the use of plates and of fin-like appliances which he calls "flippers." The plates are simply flat pieces of wood, somewhat oval in shape, which are attached to the hands and feet. They are said to give much greater force in the stroke and to offer the least possible resistance to the swimmer in preparing for the stroke. Two excellent swimmers, swam with the plates, one carrying 42 lbs. weight on his neck while swimming by aid of the plates. Another swimmer in uniform as a soldier swam with a rifle round his neck, a knapsack, weighing 60 lbs., on his back, and his ammunition tied to the top of his shako, where it was untouched by the water.

The Flight of Man.—The Aëronautical Society has now been in existence about ten years, and, although it has not yet solved the problem of flight, it has, by the energy and perseverance of its members, done much towards obtaining a result which, if not so satisfactory as might have been expected, is not an absolute failure. The present report, which has for a frontispiece an illustration of Moy's aërial steamer, contains a brief, though we believe complete account of what had been done or was doing in the past year. The ninth annual report was issued during the year. Mr. D. S. Brown contributes a paper on his Aëro-biplane. Mr. James Armour, C. E., sends a long paper on "Resistance to Falling Planes on a Path of Translation," and Mr. S. J. Bennett contributes some interesting "Notes from France," in which several "flying machines" are illustrated and described. From the concluding remarks, which refer chiefly to Mr. Moy's experiments at the Crystal Palace, we learn that the latter has succeeded in making a small steam-engine capable of yielding 3-horse power, and weighing only 80 lbs.

A New Flying Machine.—Mr. J. Simmons, C.E., made some experimental trials of a new description of flying machine at Chatham Lines recently. The machine is intended for use by an army in the field, so as to enable a person to be raised by means of the wind to whatever elevation required to reconnoitre the movements of a hostile force, and to ascertain the whereabouts of an enemy's position. Mr. Simmon's displays for this purpose a number of parakites, which are in reality huge square-shaped kites, the material of which they are composed being French cambric covered with a coating of bird-lime and india-rubber. Each parakite is balanced by a long tail composed of goosequills. The first parakite raised was a few feet square, and on the required height being obtained it was fastened to another of the same description, somewhat larger; a third and fourth were subsequently raised, and a height of about 1,200 feet attained by the smallest of the parakites, the lifting power being such that with about a dozen men holding on to the ropes a drummer-boy was raised from the ground by the pulling force of the parakites. At this moment, and just as the fifth parakite was about to be raised, one of the rods used for stretching the machine gave way, rendering it useless. The largest of the five parakites, which is 25 feet square, was then raised, when it was found to have a lifting power sufficient to raise a man. Almost immediately afterwards the rope gave way from the immense strain of the four parakites, and the whole came to the ground.

Subsequent experiments tended to show that this new flying machine might be developed into a most valuable aid for purposes of reconnoitring.

Looking out from a Balloon.—In a communication to the Academy of Sciences M. A. Moret states that during a recent balloon ascent off Cherbourg with M. Duruof they were surprised, at a height of 1,700 mètres, to see the bottom of the sea in its minutest details, though the channel at that point must be 60 or 80 mètres deep. The rocks and under currents were clearly visible. He suggests that balloon observations might prevent shipping disasters due to deficiencies in charts.

XXIV.—ASTRONOMY.

Cosmic Dust.—We mentioned some time ago (says *Galignani*), a curious paper in which M. Tissandier described the shape of certain metallic particles of dust collected from the atmosphere. We now find in the *Philosophical Magazine* an account of Professor Nordenskiold's researches on the same subject. On the occasion of an extraordinary fall of snow which took place at Stockholm in December, 1871, the Professor was curious to know whether the snow, so pure in appearance, did or did not contain any solid extraneous particles. He accordingly collected a large quantity of snow on a sheet, and obtained a small residue after it had melted away. This remainder consisted of a black powder resembling coal; heated, it yielded a liquid distillation; calcined, it was reduced to red-brown ashes. Moreover, it contained a number of metallic particles attracted by the magnet, and giving all the reactions of iron.

In a large city such an experiment could not be considered conclusive, and Professor Nordenskiold, therefore, during his Polar voyage in 1872, when he was blocked up by ice as early as the beginning of August in about 80 degrees N. latitude, before reaching Parry's Island, to the north-west of Spitzbergen, examined the snow which covered the icebergs, and which had come from still higher latitudes. He found it strewn with a multitude of minute black particles, spread over the surface or situated at the bottom of little pits, a great number of which were to be seen on the outward layer of snow. Many of such particles were also lodged in the inferior strata. This dust, which became grey on drying, contained a large proportion of metallic particles attracted by the magnet, and capable of decomposing sulphate of copper. An observation made a little later upon other icebergs proved the presence of similar dust in a layer of granular crystalline snow situated beneath a stratum of light fresh, another of hardened, snow. Upon analysis this matter was found to be composed of metallic iron, phosphorus, cobalt, and fragments of diatomaceæ. It bears the greatest analogy to the dust previously collected by the professor on the snows of Greenland, and described by him under the name of "kryokonite."

Seen at Port Said.—A remarkable meteor was observed at Port Said and Suez about 8 p.m. on the evening of June 15. One account described it as a jet of white light directed northwards, and resembling a rocket. It was followed immediately by a sound like that of distant thunder approaching very rapidly. The detonations were alarmingly powerful. An appearance like that of a comet remained for some seconds after.

Portable Transit Instruments.—In the Scientific Loan Collection at South Kensington was exhibited a portable transit instrument, by Steinheil, in which the telescope-tube forms the axis of the instrument, the rays of light from a star being reflected into it by a right-angled prism fixed outside the object-glass and turning with it so as to sweep in the plane of the meridian, the telescope-tube lying east and west. A somewat similar instrument on a very much smaller

scale has now been constructed by Steger of Kiel. The whole fits into a box six inches square, and is a marvel of compactness; but it is a question whether an ordinary sextant would not serve the purpose of determining time better, as the adjustments of a small transit are not easily determined with accuracy, and are very liable to disturbance, so that portable instruments are apt to become mere toys unless handled with extraordinary care.

The Resisting Medium in Space.—The argument for the existence of a medium in the interstellar spaces which is sufficiently dense to affect the movements of the planets, comets, &c., has for a long time been based solely upon the supposed retardation of the movements of Encke's comet. This body completes its orbit around the sun in about three years, but has of late always appeared so exceedingly faint as to be invisible except in the most powerful telescopes. The accurate computations of Von Asten having shown him that the movements of this body, as observed during the last ten years, could be accurately accounted for by a careful computation of the disturbing attractions of the planets, he was led to predict the positions in which the comet should appear during the spring of 1875, in which predictions no allowance was made for the resistance offered to its motion by Encke's hypothetical ethereal medium. The first glimpse of the comet during this season was obtained by the observers at Washington in charge of the great equatorial. According to these and other astronomers, the comet passed in the heavens through a path so nearly accordant with Von Asten's predictions as to annul all arguments in favour of Encke's hypothesis, unless, indeed, it be so modified as to attribute to this other a density far less than he supposed it to possess.

A Brilliant Spectacle.—Mr. J. Cockburn, of Darn Hall, Eddleston, N.B., on the night of the 23rd of September, when taking a photograph of some of the stars, saw the brightest meteor that he has seen for two years. The time was 9·51 p.m. it lasted about 1½ seconds, and left a train which was visible fully half a second after the disappearance of the meteor. The colour was a darkish green, and the train was orange. Its course was from above *α* Lyræ across the Galaxy towards Aquila. It disappeared before it had quite crossed the Milky Way. Dr. J. E. Taylor, of Ipswich, writes that on the night of the 24th a meteor fell there about 6.30, directly over the planet Saturn. The path described by the meteor was about one-sixth of the sky. Dr. Taylor never saw one so brilliant. The meteor seemed to burst before reaching the horizon, as if it had exploded. For nearly ten minutes the line of white cloud the meteor left behind it was visible, until at length it broke up into patche d away. This same meteo was seen over a wide extent of country —at Broadstairs, West Deeping, in Lincolnshire, Ipswich, Walton-on-the-Naze, Somersetshire, between Dunkirk and Calais, and at Paris. *Galignani* of the following day says:—"A meteor of extraordinary brilliancy was seen in Paris during the twilight yesterday evening at 6.40. In the northern heavens, at an angle of 30° above the horizon, a fiery globe, about the size of a cricket ball, seemed to emerge from the clear sky, descending slowly towards the earth, emitting showers of sparks and a scintillating train in its flight. It fell almost perpendicularly, and grew elongated in falling. It had hardly flashed into sight when it disappeared behind the houses, where it must have burst, for the whole northern sky was illuminated with two successive blazes of fire like

lightning, by which the surrounding clouds were tinged as if with gold. The effect was extremely beautiful." —*Nature.*

Popularising Science. — The question how far the work of popularising science may legitimately be extended is one which is perhaps not very easily answered, but if we might venture to point to a recent example we should say that the Dean of Cashel had carried the process quite as far as it could conveniently go. A Tipperary paper devotes some columns to the dean's lecture on "The Moon, considered as our Neighbour, Companion, and Friend," and the way in which he makes merry over the lunar orb and our relations with it is, in a scientific man and grave Church dignitary, something astounding, After a dissertation on our partner's fickleness and our own, the very rev. gentleman says, "Still, like good, generous husbands, we make up to her for many of our shortcomings, and we actually give her about fourteen times as much light as she gives to us—a very fair allowance, perhaps an extravagant one, especially for people who have to borrow all they give."

Having prepared our minds by this little sally—by no means the first in his lecture—the dean goes on, "I have said that our bright companion travels round us at the rate of forty miles a minute. Indeed, we're a lively pair, for we ourselves are meantime travelling along at the rate of seventeen miles a second, and carrying her along with us. Did it ever occur to you that whenever you take off your hat to a lady in the street you go between 30 and 40 miles bareheaded through the air, but you never catch cold from such an act of courtesy?" Having by this digression shewn the immunity of the courteous, the dean proceeds to his climax by informing us that "this sprightly companion of ours has another motion round her own axis, or, to make it more familiar, she whirls about on her toes, and, not to be outdone by her, we whirl about on ours in the same way, and then we waltz away for ever through the great drawing-room of space."—*Pictorial World.*

Spectrum Apparatus of the New Observatory at Potsdam. —The maker of the optical apparatus for the Bothkamp Observatory has lately finished the spectrum apparatus for the new Observatory at Potsdam, which probably is the most complete instrument of its kind. The maker, H. Schroeder, says of it that the apparatus consists of twenty-one single prisms combined into a system according to Rutherford's method, they being moved automatically and in such a way that the motion is accomplished with mathematical accuracy and with the greatest ease. This automatic movement allows of exact differential measurements with hitherto unattained accuracy, and is the first apparatus of this kind that has been constructed as an exact instrument for measuring. According to Dr. Vögel, the measurements are perfectly trustworthy to the one-hundredth part of the interval between the double-line D of sodium, the optical performance of this spectroscope being such that the sodium line is separated into nine fine lines. Almost all the principal lines of the spectrum are resolved into groups of lines, while new lines are seen among those hitherto known.

The Sun's Atmosphere. — Professor Langley, of Allegheny Observatory, has lately published some results of his steady observations of the solar atmosphere, which, he states, is a thin stratum which cuts off one-half the heat which otherwise would reach us. From this it appears that the existence of living beings upon the earth is directly dependent upon the sun's at-

mosphere, for should that envelope be increased 25 per cent. in thickness, the mean surface of our globe would, it is estimated, be reduced 100° Fah. in temperature. It has been suggested that the glacial epoch through which the earth passed many ages ago might have been due to a fluctuation in the solar atmosphere.

The Minor Planets of 1875.—Fifteen minor planets were discovered in 1875, the latest discovery being No. 155. This asteroid was detected by Herr Palisa, at the Pola observatory in Austria, on the 8th of November. In 1868 twelve were discovered, and that number was never exceeded until last year.

A Meteoric Stone.—A meteoric stone weighing 8lbs., which is believed to have fallen during a storm in the month of April, was dug out of a meadow near the Wellington and Market Drayton Railway, about a mile north of Gradgington station. It was found to have buried itself to a depth of 18in., including 14in. of clay.

Luminous Meteors.—At the Glasgow meeting of the British Association, Professor Herschel read the report by Mr. Glaisher of the committee on "Luminous Meteors." He referred to the fact that the committee had been as successful during the past year with reference to the accumulated observations of meteors as had hitherto been the case, although on another point he had less satisfaction in stating the results of their endeavour to provide for the continuation of the observations. It was intended during the present year to produce charts and a list of radiant points in such form that observers might immediately avail themselves of the labours of their predecessors; but these maps and lists were only in manuscript, and were not yet printed.

The report stated that of meteors and meteor-showers there had been a large supply. Large fireballs were seen on the 3rd, 7th, and 14th of September last, and were observed over such an extent of country as to allow of their real heights and paths being calculated with a somewhat unusual degree of accuracy. The paths of those meteors were calculated by Captain Tupman, of the Royal Observatory, Greenwich, and very satisfactory conclusions had been arrived at as to the probable meteoric showers to which these fireballs—two of which were detonating—appeared to have belonged. One of the largest of these bodies was seen in bright sunshine on the 22nd of December, 1875. Another of great brilliancy was noticed on the 25th of July last. Meteors of this conspicuous character appeared also on the 16th of August, 1875, and on the 15th of April, 11th, 15th, and 21st of August in the present year (1876).

The occurrences of meteor-showers had been during the past year very slight and ill-defined, with the exception of the August displays of this and last year. The shower of the present year was less plentiful than had been visible for several years past, and had amounted to a real minimum of intensity of its usual apparitions. One of the most interesting of meteoric showers took place this year in England, when a mass weighing seven and a half pounds fell at Rowton, near Wolverhampton. That was only the seventh instance where a mass of iron of meteoric origin had actually been seen. The event took place in Shropshire, at a quarter to four o'clock on the 20th of April this year.

Mr. Herschel, in speaking to the report, referred to the meteor of 14th September as one of the largest and most brilliant which had been seen for many years. The meteor of September 3rd descended vertically over

the sea a few miles from the coast of Sussex, finishing with a flash as bright as the sun. That of September 7th was a detonating meteor, and it began its course over Hythe and Folkestone, and terminated over Cheltenham. Its course was about 80 miles, beginning at a height of 69 to 70 miles above Kent, and terminating about 22 miles above Cheltenham. The meteor of 14th September was a very brilliant one, and, like the preceding, was a detonating one.

Meteors such as these, capable of precipitating solid substances to the earth, were not of frequent occurrence, and those narrated were the only instances of the kind they knew of. Another meteor on 25th July was what might be called a green one, and although its light was not so intense as that of 14th September, it still was very brilliant. With reference to the mass of iron, he said that its fall was not attended by any meteoric action. The sky was cloudy, and it was also raining; and it was found out by the farmer who, when passing over his field, discovered an excavation in the turf. He probed it with his stick, and discovered the mass of iron still so hot that he could not hold it in his hand. The specimen was now in the British Museum.

The Progress of Astronomy during the last Ten Years.—In a lecture delivered in 1875 to a society of natural science in Dresden. Dr. Neumann gave a sketch of the progress of astronomy during the previous decennium:—

Taking first the solar phenomena, he stated that Carrington discovered from a large number of observations during seven years—

1. A motion of the sunspots towards the equator.

2. That this movement is in a direction contrary to that of the rotation of the sun.

3. That the spots seem to get divided through a certain whirling motion of their parts.

4. That new spots more readily appear where others have previously disappeared.

5. That there are certain regions which seem specially suited for production of spots.

6. That there is a periodicity in the frequency of the sunspots. The last years in which the spots were most numerous were those of 1828, 1837, 1848, 1860, 1872.

Spörer, in Maklam, who disputes the existence of special spot-forming regions in the sun, observed with Heinrich Weber in Peckeloh—

7. The existence of several faculæ-regions in the sun; and, on the other hand,

8. The occurrence of vacant bands.

The English observer, Howlett, and Edward Weiss in Vienna, observed—

9. The moving away of some dark spots over others.

From further observations of Spörer and Secchi it appeared—

10. That the penumbræ may be decomposed into numerous small dark spots.

11. That the spots occur over brighter surfaces, and the various shadings of the nuclei are simply due to the fact that the brighter surface beneath comes out, more or less. Even the darkest nuclei appear, with strong magnification, torn and crossed by fine lines of light.

A decided progress in the region of solar observations was made on occasion of the total solar eclipses of 15th Aug., 1868.

12. That the protuberances belong to the sun, as they showed agreement at stations most widely apart.

13. The corona was still regarded (provisionally) by most observers as an optical phenomenon.

14. The circumstance that Herschel, Janssen, and especially Rayet, with the aid of the spectroscope, per-

ceived a number of brightly luminous bands when they examined a large protuberance, made it certain that the protuberances are of a gaseous nature.

15. Since the line, C, in the red, and the blue F, which both belong to hydrogen, came out with peculiar distinctness, it was inferred that the protuberances consist of glowing hydrogen.

Janssen's discovery, that that remarkable phenomenon may be observed at any time with the spectroscope, without an eclipse, led to the following facts :—

16. The protuberances change with great rapidity, and can even be observed, where there is much accumulation, in front of the sun's disc.

17. Besides the bright hydrogen line, C, there are other lines.

18. The entire sun is surrounded by an envelope of the gas 8,000 to 12,000 kilometres in height, which forms the protuberances, and the latter are merely local accumulations of this envelope.

19. Between the sunspots and the protuberances there is a certain connection.

20. In the neighbourhood of the sunspots there are frequently aqueous vapours.

21. The sunspots lie lower than their surroundings.

Zöllner regards them as slag-like local products of cooling on a glowing liquid surface.

22. A maximum of the frequency of protuberances occurs between May and June; a minimum between September and November.

23. They are highest in the regions where they are most numerous. The greatest height observed by Secchi was about 30,000 geographical miles.

24. The faculæ appear most numerous in the zones where the protuberances are most numerous.

25. Secchi has also observed eruptions of various kinds, and Tacchini, in Palermo, has made the discovery that enormous surfaces in the sun are filled with magnesium vapours.

The following are some of the points Dr. Neumann noticed in connection with the planets :—

Mercury.—Nogel, at Bothkamp, on the 14th and 22nd April, 1871, discovered spots, and Zöllner's observations gave the result that the nature of the surface of Mercury is similar to that of our moon.

Venus.—This planet is most probably surrounded by a very dense atmosphere, so that to see through to the surface of the planet is not possible; whence arises the impossibility of determining, from the frequently observed spots, the time of rotation and position of the axis.

Earth.—The recent determinations of the mean density give the results 5·56 and 5·5.

Mars.—From a careful comparison of over 400 drawings of this planet, a result is obtained which, in consequence of the marked divergences between the several drawings, especially with large refractors, does not correspond to the labour expended.

Planetoids—The labours of Messrs. Watson, Luther, Tempel, and others are ever leading to new discoveries, and the number may reach 200 before very long.

Jupiter.—The occurrence of coloured bands in this planet, and the formation of bright egg-shaped spots in his equatorial zone, coincide with the epochs of greatest frequency of the sunspots.

According to Schmidt, in Athens, the rotation time is 9h. 55m. 25·7s. Vogel and Lohse have observed a flattening of $\frac{1}{15 \cdot 8}$; while Angelmann from calculation, has determined it as $\frac{1}{15 \cdot 82}$.

Saturn.—In this planet, as in Venus, Mars, and Jupiter, Secchi finds the occurrence of dark absorp-

tion bands in the neighbourhood of the Fraunhofer lines B and C, and on both sides of D. As these are similar to the absorption bands which arise in the sun's spectrum, principally under the influence of the earth's atmosphere, through the action of aqueous vapour, Secchi infers the presence of aqueous vapour in the envelope of Saturn, as in those of other planets.

Uranus and *Neptune* give each a different spectrum.

Of our *moon* it is noticeable that, according to numerous observations, there is still volcanic activity in it.

With regard to *comets*, it is proved that their light does not exclusively come from the sun; but that it partly belongs to themselves. Schiaparelli's proof that between some comets and star-showers there is a close connection, is also of great importance.

The *asteroids*, *fixed stars*, and *nebulæ* have been extensively observed. The number of the last named in Herschel's catalogue of 1863, was 3,078.—*English Mechanic.*

XXV—MISCELLANEOUS.

Bell-ringing made Easy.—A chiming apparatus, invented by the Rev. H. P. Ellacombe, rector of Clyst St. George, Devon, has been fixed in the church of Moreton-on-Lugg, Herefordshire, by Messrs. Hooper & Stokes, church bell-hangers, of Woodbury, near Exeter, by which means the whole peal of six bells can be easily chimed for service by one person. Ball hammers are suspended beneath the mouths of the bells, out of the way of the swing of the bells, and by a system of pulleys the ropes connected with these hammers are brought down in parallel lines to a manual fixed on the belfry wall. When the manual is put into gear for use, the ropes are all tightened, and the hammers thereby raised nearer to the bells, so that a slight pull at each rope causes the hammer to strike the bell. One person, therefore, standing in front of the manual, can readily chime all the bells by simply pulling rope after rope, or he can play a tune by varying the fingering of the ropes.

Spell Ipswich.—Mr. C. T. Townsend, the Danish and Norwegian consul at Ipswich, has for the last three or four years received letters from Northern Europe, on the envelopes of which are some extraordinary variations in the spelling of the name of the Suffolk capital. Subjoined are no fewer than fifty-seven of these incorrect orthographies:—Elsfleth, Epshoics, Epshvidts, Epsids, Epsig, Epsvet, Epsvidts, Epwich, Evswig, Exwig, Hoispis, Hvisspys, Ibsvi, Ibsvig, Ibsvithse, Ibwich, Ibwigth, Iepsich, Ie yis Wich, Igswicld, Igswig, Igswjigh, Ipesvivk, Ipis Wug, Ips Witis, Ipsiwisch, Ipsovich, Ipsveten, Ipsvick, Ipsvics, Ipsvids, Ipsvidts, Ipsvig, Ipsvikh, Ipsvits, Ipsvitx, Ipsvoigh, Ipswch, Ipsweich, Ipswgs, Ipswiche, Ipswick, Ipswict, Ipsweiech, Ipswig, Ipswigh, Ipswight, Ipswish, Ipswith, Ipswitz, Ispich, Ispovich, Ispwich, Ixvig, Iysuich, Uibsvich, and Vittspits. It is only due to the deciphering powers of the postal authorities to say that these letters generally come to Mr. Townsend without delay. Occasionally a North Europe communication goes to Wisbeach instead of Ipswich, or *vice versâ*.

Rings of Smoke.—At one of the *conversaziones* Sir W. Thomson exhibited the vortex smoke-rings. A box of about three feet square has a circular hole of about six inches in diameter cut in its front face, and the back is covered by a piece of tightly-stretched canvas or linen. The vapours of ammonia and hydrochloric acid are admitted to the box, which soon becomes filled with the white smoke of chloride of ammonium. A sharp but gentle tap on the canvas back drives out a puff of the smoke, which traverses the room in the form of a beautiful ring. So great a velocity can be imparted to these vortex rings that even when at a considerable distance they have power enough to extinguish candles. The experiment is remarkably simple, and with a little care in securing good ventilation, it may be performed without injury to persons or things in a drawing-room.

Novel Playing-Cards.—A novelty in "playing-cards" has just been introduced from America. It

consists in having the value of the cards placed in the left-hand corner at the top, and the right-hand corner at the bottom. For instance, the nine of diamonds has a figure 9 with a small diamond beneath placed in two corners, top and bottom; the queen of hearts has the letter Q, with a small heart beneath, likewise in the two corners. The advantage of this plan is that, by slightly fanning the cards in a hand of whist, or any other game, every card with its suit and value can be seen at a glance, although the face of the cards is not exposed to view. The cards are also remarkable for their flexibility, slip, and durability.

A Candle in a Walking-cane.—A very simple walking-cane, with a candle inclosed, which might be convenient for use in dark passages, or even for reading in railroad cars, has been introduced by a German firm. The top portion consists of a hollow cylinder screwed on, and containing a spring to press upward, as fast as consumed, a candle placed in it. It is closed by a screw-cap, which forms a convenient top.

Fifteen American Triumphs.—Fifteen great American inventions which have been adopted all over the world are the following:—1. The cotton gin. 2. The planing machine. 3. The grass-mower and grain-reaper. 4. The rotary printing press. 5. Navigation by steam. 6. The hot air (caloric) engine. 7. The sewing machine. 8. The india-rubber industry. 9. The machine manufacture of horseshoes. 10. The sand blast (for carving). 11. The gauge lathe. 12. The grain elevator. 13. The artifical manufacture of ice on a large scale. 14. The electro-magnet, and its practical application, by Henry and Morse. 15. The composing machine for printers.

Petroleum in Gallicia.—An article in the *Journal Officiel* says:—On the north and north-eastern slopes of the Carpathian chain there exists a series of strata of argillaceous schist or clay-slate, which, at many points, manifest themselves as oil-conductors. There are three principal groups of these on an extent of about 185 miles, English, in length, and fourteen miles in breadth; the first begins at Kluzany and ends at Librantow, Western Gallicia; the second stretches out from New Sandescz to Jaslo, Central Gallicia; the third from the circle of Jambow to Drohobyez and Borryslaw. Opinions are divided as to the origin of the discovery of petroleum (called naphtha and *ropa* by the people) in those parts. The volatile ingredients of the oil pass through the crevices of strata of decomposed coal, which are most abundant in those sections of the mountain-chain that have been exposed to the strongest convulsions. The presence of petroleum is also manifested by atmospheric signs, such as gaseous emanations floating in the air.

The wells have a depth that sometimes renders the work of extraction both difficult and dangerous: continual ventilation is a necessity; but, on the other hand, the most abundant streams of water and gas are always followed by a richer crop of oil. In shallow wells not exposed to the pressure of water and currents of gas, nothing but thick petroleum, tar, bitumen, or mineral wax, is generally found.

The machinery used for extraction is still very defective. Springs of iodised and sulphuretted water are frequent in the oil districts. The purity of the oil increases with the time during which the well has been worked. The first attempts to extract petroleum date as far back as fifteen years. The present wells have a depth of between forty and fifty fathoms; there are also mere round holes that are emptied

by hand-pumps twice a day; and the total quantity of oil obtained amounts to fifty millions of kilogrammes per annum. The larger proportion of the yield is consumed in Austro-Hungary, where there are many refineries of the article.

An Ingenious Toy.—An ingenious toy, apparently of Japanese origin, has recently been introduced into London. It consists of a small picture, on paper, of an individual pointing a firearm at an object—bird, target, or second person. By the application of the hot end of a match, just blown out, to the end of the gun, the paper commences to smoulder towards the object aimed at, and in no other direction. When it is reached, a report is heard from the explosion of a small quantity of fulminating material.

Cheap Meerschaums.—Meerschaum shavings or dust are used when compressed for making inferior or imitation pipes. 41,000 cwt. of this waste are annually consumed in Vienna in the production of pipes, cigar-holders, &c., and the imitation has been carried to such perfection that connoisseurs sometimes find it difficult to distinguish these articles from similar ones of the genuine substance. Of the meerschaum itself 12,000 cases, each weighing fifty or sixty pounds, and worth 35*l.* a case, are used up in Vienna alone. In working up the shavings and dust into material, about sixty women are employed in Vienna, in sorting, sifting, washing, and cleaning the refuse, and rubbing it through silken sieves.

The Emperor Bell.—The third largest bell in use in the world was recently placed in the southern tower of the cathedral in Cologne, Germany. Three castings were made, of metal obtained by melting French cannon captured during the Franco-Prussian war. Two were unsuccessful, but the third was perfect. The twenty guns used weighed 50,000 German pounds, and to these was added 80,000 pounds of tin. The time of melting was but ten hours, and twenty-nine minutes sufficed to fill the mould. The cooling continued for four weeks. The bell is 10 feet 8 inches high, and 11 feet 2 inches in diameter. Its total weight is over twenty-five tons. Of the larger bells in existence, two, those of Moscow, weighing respectively 193 and 63 tons, are broken. Pekin has one bell weighing fifty-three tons, and Novgorod, Russia, one of thirty-one tons—both of which are in use.

Glue for Mending Glass and Earthenware.—For mending glass utensils and earthenware, glue mixed with bichromate of potash seems to be particularly suitable, for any fracture is firmly mended by means of the compound. A strong solution of glue or gelatine is made—the latter is employed when the work is to be done neatly—by dissolving five to ten parts of dry gelatine in water, and for every five parts of gelatine employed, one part of bichromate of potash is added. The mixture is kept from the light till required for use, and the two surfaces of a fracture are coated with it, and then pressed or fastened together with a string. Placed in the sunshine, the bichromated glue soon becomes hard and insoluble, and after a few hours the broken object is found to be firmly cemented. If the work is done neatly, the crack is scarcely to be seen, and even hot water will fail to dissolve the glue, which has, of course, been fixed by the light. Chrome glue may also be used to prepare waterproof articles, the material being stretched, and coated two or three times with the solution, and exposed to light. To waterproof portmanteaus and bags in this manner would be a most economical proceeding; but we think the proposal to add a small percentage

of glycerine to the gelatine should be attended to, as otherwise the covering would be a very brittle one. *Dingler's Journal* recommends its employment for roofing purposes, to fix the tar and add to its waterproofing qualities, and it states that a winter's rain upon a roof treated in such a way had not any injurious effects. There can be no doubt that many capital applications might be made of the material, especially by photographers, who understand the qualities of the mixture so well. Some time ago, we believe, a patent was taken out for coating the walls of apartments with the composition to render them waterproof, but we do not know whether it still stands.—*Photographic News.*

Cheap Cigars.—Those who cannot afford high-priced cigars would do well to shun the cheap ones, which are said, on the authority of a Parliamentary return, to consist of "sugar, alum, lime, meal, rhubarb leaves, saltpetre, fuller's earth, starch, chromate of lead, peat moss, treacle, common burdock leaves, common salt, endive leaves, lampblack, gum, red dye and black dye composed of vegetable red, iron, and liquorice." "Havanas," at one penny each, "are sometimes steeped in an infusion of strong tobacco-water, to give them a little external flavour of a true kind."

A Fireproof Suit.—A native of Sweden has been making some sensational experiments in London with a fireproof suit. This is made in two layers, the inner one of india-rubber, the outer one of English leather, the head being protected by a helmet resembling that worn by divers. At the girdle is fixed a piece of hose, which serves both for air and water. The air-pipe, fed from two blowers, is placed inside the water-pipe, and brings the air, after being cooled by the surrounding water, into the inner part of the dress. The air inflates the costume, passing away through the two small openings made for eye-pieces. The current of air not only keeps the enclosed body cool, but drives smoke and flame away from the eyes. At the back the water-pipe divides, one branch serving as an extinguisher, the other passing into the outer coating of the dress, the stream being distributed over the whole outer surface. With the apparatus on, the experimenter stood in the middle of a pile of burning shavings and logs, without the least injury.

Overcrowding in Liverpool.—A paper was read by Mr. R. W. Pitcher before the British Association on "Overcrowding in Liverpool," which was stated to be now greater than the overcrowding of any other city. Mr. Edwin Chadwick stated that nearly a double death-rate as compared with comparatively well-conditioned cities, denoted the unhealthy condition of Liverpool, and was due mainly to overcrowding. The experience of the results obtained by the sanitary regulations of the common lodging-houses in the metropolis—where, by the enforcement of drainage and cleansing, ventilation, and a limitation of the numbers who might occupy a room, former fever nests had been abolished, and the occupants put in a condition far in advance of the general wage-classes, suggested the expediency of the extension of the lodging-house regulations to weekly tenements, the occupants of which in such a city as Liverpool were in great part as changeable as the occupants of the common lodging-houses. Most certainly, however, the existing old tenements admitted of very great, and by no means expensive, sanitary improvements, if the work were properly set about, which the local authorities did not appear of themselves to be very competent to do. The next great remedy, however, leading to the construction of improved tenements in places where

land was less expensive, was, the paper indicated, in extending the means of cheap transit. Great relief had already been given by cheap and improved tramways with tram-cars, of which Glasgow presented very good examples. Science also was bringing forth improved and cheapened locomotion by noiseless and inoffensive steam power, as well as improved cars, of which Brussels was presenting examples. Against all extensions, however, cities were hidebound, as it were, by the state of their road administration, and it would be necessary for civic improvement that the whole area of a city's relations should be brought within a competent and comprehensive ward administration. Great improvements in the quality and economy of tenements would be found in new concrete constructions.

A New Fire-Extinguisher.—New and important experiments have been made in New York in extinguishing fires by a new process. The *New York Herald* of March 1 reports that, in the presence of General Shaler, members of the fire department, and gentlemen connected with the Board of Underwriters, the Chamber of Commerce, and insurance companies generally, the Connelly fire extinguisher was exhibited in an open lot at the corner of Fifty-ninth-street and Eleventh-avenue. A large frame building had been erected, in which were placed three cylindrical reservoirs, filled with carbonic acid gas, and adjacent were eight other cylinders used as receivers, from which the gas escaped into the hose. An immense pile of barrels—two barrels deep, and about five barrels high — the pile containing altogether 130 barrels of refuse resin, both ends of the barrels being open, stood at the east end of the lot. A smaller pile of boards, with two barrels of refined oil on the top, like the funeral pyre of Brutus, stood a little east of the resin, and to the westward was a tank four feet deep, built of brick and cemented, and having a surface area of 60 square feet, containing 375 gallons of crude petroleum, and into which sluice pipes emptied water. The tank full of oil and water was fired first, and a tremendous mass of flame and smoke arose, driving the crowd right and left by the intense heat. In less than five seconds this great mass of flame, as thick as four or five ordinary brick houses, and three times as high, was extinguished by the stream of water expelled from the hose by the force of carbonic acid gas. The noise made was like that caused by a thunderstorm rushing through a mountain pass. Next the 130 barrels of resin were fired, and were extinguished in less than six minutes by a rapid stream ten times stronger than that which could be expelled by a steam-engine from a nozzle of the same diameter; and, lastly, the funeral pyre was lighted, and, blazing as it did with great intensity, was extinguished in a few minutes. The experiments were in every way successful, and introduced a new agent of the most powerful kind for the saving of property.

The Properties of Gallium.—The recently discovered metal gallium melts (says the *Medical Press and Circular*) at 81·1° Fahr., so that it liquefies when held in the hand. When solid, the metal is hard and resistant, even to a few degrees below the melting point. It can be cut, and possesses a slight malleability. When fused, it adheres easily to glass, on which it forms a beautiful mirror, whiter than that produced by mercury. It oxidises but very superficially when heated to redness in the air, and does not become volatile. The density at 59° Fahr. is 47, that of water at 39·2° Fahr., being 1.

Excepting mercury, which only becomes solid at 37·9° Fahr., there is no other element which liquefies at so low a temperature as gallium.

The Names of London Streets.—In the last twenty years the Board of Works has revised the names of 1,916 streets, and abolished 6,740 names of portions of streets, rendered unnecessary on re-numbering the whole street. The board has given new numbers to 140,409 houses. A general index of the names of existing streets has been compiled, and an index of abolished names, and plans of all the revised streets, showing the old and new numbers against the block plan of each house; these plans are bound up in atlas form for reference and the identification of properties. The superintending architect of the board reports the practice followed in numbering houses:—"St. Paul's Cathedral is recognised as a central point, and the numbering of houses, when altered, and also in new streets, begins at the entrance or end of the street nearest to that building; but where both entrances to a street are about equally distant from St. Paul's, the numbering begins at the entrance abutting on the most important thoroughfare. Taking, then, the sides of the streets as left and right (assuming that the back is towards St. Paul's), the odd numbers will be assigned to the left-hand side, and the even numbers to the right-hand side. No name is to be used for a street without the approval of the board; and it must be a name consisting, if possible, of one word (with the addition of 'street') not already in use in the metropolis in street nomenclature. Names for terraces or other blocks of houses and sections of streets, usually known as subsidiary names, will not be recognised; nor such names as are already in use for provincial towns and postal places." The superintending architect mentions in his report, in 1875, that, on the suggestion of the vestry of Chelsea, the new approach from Queen's-road West to the river adjoining Chelsea Hospital is named "Tite-street," and the short street connecting the latter with Swan-walk, "Dilke-street;" and, under the regulations adopted by the board, Chelsea has a species of copyright in these as London street-names. —*Illustrated London News.*

A Huge Diving Bell.—A diving bell, twelve feet in diameter, and ten feet six inches high, was recently turned out of the Perseverance Works, Deptford, and taken to the West India Docks for shipment to Barbadoes. It is intended to be used in the construction of new docks and a breakwater.

The Immediate Extinction of Fires.—A thoroughly practical, efficient, and inexpensive method for rapidly and effectually extinguishing fires, has been invented by Mr. Julius Hall, the well-known patent agent, of Chancery-lane. In applying the invention to large buildings, such as theatres, warehouses, stores, &c., Mr. Hall provides around the ceiling of each room, or warehouse, a cornice of two-inch piping, the lower part of which is perforated with two or more rows of holes, to allow the water when pumped in to be distributed into the warehouse or room in the form of rain. At any convenient part on the outside of the building, a metal box is fixed (incased in an iron-bed) having two or more junctions, for the purpose of affixing the engine-hose to; from this box vertical pipes are fixed, having taps; the other end of the vertical pipe is fixed to the cornice. On a fire breaking out on any one floor, the engine-hose is fixed to the junction, the proper taps turned on, and the water is then forced up the vertical pipe, and falls from the cornice. The invention is equally ap-

plicable to ships, and deserves general public attention.

Lock-makers and Lock-breakers.—An exciting contest is just now being carried on in America. The contest is between lockmakers and burglars. Till recently the lockmakers appeared to have decidedly the best of their opponents, and neither picklocks nor drills nor blasting-powder could prevail against the ingenuity of the locksmiths. Latterly, however, the burglars have been resorting to what cannot but be regarded as a very mean trick to overcome their opponents. When a lock defies their utmost exertions, they kidnap the bank clerk who has charge of the keys, and whose friendly co-operation is secured by means of a rope placed round his neck, and gradually twisted tighter with every successive demand. This, as the locksmiths complained, could not be considered fair fighting, and the contest having been carried quite beyond the boundaries of their domain, they might without discredit have declined further efforts.

Once more, however, the rogues seem likely to be checkmated. A clockwork mechanism has been adopted in some of the banks, which, when once a safe has been locked, keeps it locked for a certain number of hours. Thus, a safe closed at the end of the day's business cannot be opened even by one who has charge of the keys, till business time next morning. This device is now adopted in establishments where two or more locks with separate keys are impracticable. The larger city houses are beginning to rely upon an electric contrivance, by which the mere tread of the thieves on the floor of the depository of the safe, or the first tap with the hammer not only registers the time and the locality where they are about to go to work, but gives an alarm to some dozen well-armed men, stationed at some central watch-house, ready to proceed to where they may be required.

Dredging for Amber.—According to an official report from Memel, Germany, an establishment has been organised for gaining amber by dredging for it in the Kurische Haff, near the village of Schwarzorts, situated about twelve miles south of Memel. It has been known for many years that amber existed in the soil of this place, from the fact that the dredger employed by the Government for the purpose of clearing away the shallow spots near Schwarzorts, which impeded navigation, brought up pieces of amber, which were duly appropriated by the workmen, and at the time no particular attention was paid to the matter. Some time afterwards, however, some speculators associated, and made an offer to the Government, not only to do the dredging wherever required at their own expense, but to pay a daily rent, provided the amber which they might find should become their property. This proposal was accepted, and the rent fixed at fifteen thalers, and later at twenty-five thalers, for each working day. The dredging was begun with four machines worked by men, and one worked by horses. Judging from the extended business transactions in this matter, its results must have been extremely profitable. At present, the work is carried on with eighteen steam dredges and two tug-boats, the whole managed by about 1,000 labourers.

The Tides on our Shores.—Sir William Thomson, at the meeting of the British Association, read the final report of the committee on the Tides. The tidal committee, which had been appointed several years ago, was for the purpose of promoting the extension and harmonic analysis of tidal observations. The report stated that since the

publication in 1873 of the committee's report for 1872, a large amount of work had been gone through in the way of harmonic analysis, exhausting the funds at the disposal of the committee for this purpose. It was now published for the first time, and along with it, by permission of the Royal Society, some further results obtained by aid of grants made by it to Sir William Thomson, out of the Government grant fund for scientific investigation. The work had been done for the committee, under the superintendence of Sir William Thomson, by Mr. E. Roberts, of the *Nautical Almanac* Office. The report included ten years' observations by the self-registering tide-gauge at the junction of the Mersey and the Dee; two years' observations at Kurrachee, in addition to three years' previously analysed and published; observations at San Diego, on the coast of California, Fort Clinch, Fernandina, Florida, West Hartlepool, Beechy Island, &c.

Sir William gave a general explanation of the overtides—that is, tides generated at places where the tides are large compared with the depth of water. Alluding to the spring range of tide at Toulon, he said it was 6·8 in. full, the neap tides 3·6 in., and the greatest range of tide, including the diurnal one, would never exceed 12 in. The variation of the barometer at Toulon would often cause much larger differences of tide than those occasioned by the attraction of the sun and moon. In conclusion, Sir William said it was by no means creditable to the hydrographers of the Government that they had not investigated the diurnal tides of Great Britain. It was said that the morning tides on the east coast were the highest; but that was nonsense, though in some cases of joint action of the sun and moon, the morning tide might be the highest.

Sudden Breakage of Glass.—Hagenbach states that the liability of some glass wares to fracture suddenly, without obvious cause, when exposed to small changes of temperature, and which depends on unusual degrees of expansion on the inside and outside of the objects, may be detected by examining them with polarised light, when they exhibit a more or less brilliant display of prismatic colour. In glass that has broken in this way the peculiarity is generally observable. On the other hand, the examination of a large collection of glass vessels, of good temper, which had stood the test of long wear, proved that very few indeed displayed any traces of colour when viewed by polarised light.

Writing on Glass with Common or Indian Ink.—A mode has been described to the Industrial Society of the North of France, by M. Terquem, of writing on glass with common or Indian Ink. The glass is heated over a spirit lamp, or gas, until steam ceases to be deposited in it, that is to say, 50° to 60° Cent.; a varnish composed of eighty grammes of alcohol at 95°, four grammes of mastic in drops, and a gramme of gum-sandarac heated together in a flask, is then applied to the glass. The varnish must, however, be filtered. This varnish is very hard, and becomes brilliant and completely transparent; but, if applied cold to the surface of glass, it remains opaque and absorbs ink. A sheet of glass thus prepared may be written or drawn upon with either ordinary or Indian ink; but it must afterwards be dipped in very thin gum water or another like substance not containing alcohol.

Atmospheric Germs — Their Presence and Work.—Professor Tyndall, at an evening meeting of the Royal Institution in the latter part of January, gave a discourse on

the Optical Deportment of the Atmosphere in relation to the Phenomena of Putrefaction and Infection. He began by referring to his discourse on Dust and Disease, six years ago, when he proved the organic origin of the motes floating in London air, which are revealed by their reflecting and scattering the light of a beam of sunshine or electric light, and when he showed that darkness is produced in the beam, wherever these motes are burnt or intercepted, the air being thus rendered "optically pure." He then expressed his obligations to his predecessors in this field of research, especially to Kircher, Schwann, Helmholtz, Pasteur, Budd, Huxley, Lister, and Burdon Sanderson, as well as to Mr. Cottrell, his assistant, for intelligent help.

He next proceeded to explain the apparatus expressly constructed for his elaborate experiments. After stating that he had proved that common air, in air-tight glazed vessels, will, in three or four days, deposit all its motes in the glycerine wherewith the sides are coated, and thus remain dark when a beam of light is projected into them, he gave the details of the experiments made by placing in such vessels a very great number of glass tubes, containing infusions of a great variety of animal and vegetable substances; the result being that no turbidity due to putrefaction ensued, and that none of the life-germs or the excessively minute organisms termed bacteria appeared, even after a very long time. No brilliancy ensued when a beam of light was projected through them. When, however, tubes containing such infusions were exposed to the ordinary air, in a day or two (more rapidly in a warm atmosphere) the liquids became turbid, and when illuminated disclosed the presence of the bacteria, resembling innumerable brilliant projectiles, the exceedingly minute chemists, active agents in the work of putrefaction.

Dr. Tyndall showed that the results he had obtained in the course of his experiments decidedly refute the theory of spontaneous generation. He stated that he had most carefully repeated the experiments on which the chief advocate of that theory (Dr. Bastian) relied, and had obtained entirely opposite results. For this purpose he had not only placed his infusions in filtered and calcined air, but also in air which had been deprived of its motes merely by subsidence. In regard to some of the experiments of Dr. Roberts of Manchester, which appeared to favour the theory of spontaneous generation, Professor Tyndall suggested the probable sources of error, having previously described some of his own experiences leading to similar erroneous conclusions. He also adduced reasons, based on analogies, for his belief in the absolute certainty of the existence of these living germs, innumerable and invisible; and he referred to experiments demonstrating that sewer gas is not an agent in disseminating disease when devoid of disease-germs. In regard to the various degrees of the diffusion of germs in the air, Dr. Tyndall referred to the results of the observations of a great many tubes containing infusions of all kinds, placed in all sorts of places, showing the ubiquity of these germs, and tending to prove that they float in the air in little clouds; and, finally, he referred to experiments and diagrams, by which he illustrated the way in which an epidemic disease, by means of these clouds, may spread through a large population.

[In connection with this subject the reader may be referred to the following article, and also to "Professor Tyndall on the Air and Organic Life," p. 259.]

Spontaneous Evolution and the Germ Theory.—Dr. Carmi-

chael read a paper before the British Association "On Spontaneous Evolution and the Germ Theory." The question, he said, presented was what was the origin of those organisations which appeared in certain infusions. Two answers were given: One was that the organisms had been constructed by the rearrangement of their atoms, and the other that they were the offspring of pre-existing organisms. It was shown that when certain means of protection were used life did not appear in water, while organisms were abundantly developed on its exposure to air. Certain particles which were discoverable in air, and had sufficient weight to settle when the air was at rest, seemed to be the origin of the organisms found in infusions. The germ theory was consistent with the appearance of life in exposed infusions. The next question was as to spontaneous evolution. Could infusions free from germs be caused to develop living organisms? He described a number of experiments which showed that a certain high temperature destroyed the power of germs in fluids to develop life, contrary to the conclusions of Dr. Bastian, Professor Tyndall's most prominent opponent on this subject. The conclusion come to, therefore, was that the fluids had been raised to a temperature at which the germs lost the power of life, and not because the molecular necessary to life had been destroyed. As the result of his experiments and inquiries, he thought he was warranted in coming to the conclusion (1) that bacteria germs did exist disseminated in water, air, and exposed substances; that these might remain latent and yet reveal themselves under circumstances suitable to their development; (2) that the origin of bacteria and other forms of life from non-living material had not been proved.

Dr. W. B. Carpenter said that, having read Dr. Bastian's last charge, he had listened to the reply to it in Dr. Carmichael's paper with great pleasure. Dr. Carmichael had shown there were strong grounds for believing that life-germs could not survive under certain circumstances. Dr. Carpenter alluded to the experiments of Messrs. Drysdale and Dallinger watching the infusions for any appearance of life for a long series of hours continuously. They had shown that some of the germs observed when they became cysted had broken up into atoms visible only under a power of 4,000 diameters, and which could be subjected to 300° of heat without their vitality being destroyed. He referred to his own experiments in desiccation, which showed how life-germs could be carried through the air and deposited on roofs of houses, in water, and elsewhere. He thought Dr. Bastian would find much difficulty in explaining the experiments to which Dr. Carmichael had called their attention.

Professor Tyndall on the Air and Organic Life.—It was asserted long ago by Pasteur, and has since been asserted and denied alternately by different experimenters, that in putrescible solutions, such as infusion of turnips, no organic life is developed, and no putrefaction takes place as long as the solution, after boiling, is exposed only to an atmosphere free from organic germs; in short, that life is never, in our experience, developed from lifeless matter. Among the opponents to this theory, the foremost has been Dr. Charlton Bastian, whose experiments convinced him that organic life is constantly developed in liquids which have been hermetically sealed in flasks while boiling. Dr. Bastian goes even further, as the following passage from one of his letters will show:—"I heated flasks, sealed in the ordinary way, and containing

the fluid above-mentioned [a turnip-cheese infusion], to a temperature of 105° C. for ten minutes in a chloride of calcium bath, and have found these fluids swarming with bacteria after six days."

Professor Tyndall's researches on this important subject, and the well-devised and well-executed experiments which he exhibited at the close of January, to an audience which crowded the theatre of the Royal Institution to the roof, are a continuation of those on the floating particles of the atmosphere, which attracted so much attention some years ago. He has found that these particles can be completely removed from the air by heat, which destroys their organic matter; by filtration through cotton-wool, or, less completely, through the lungs; or by deposition, which last process requires several days for its completion. The most delicate test of the freedom of the air from solid matter was found to be the passage through it of a beam of light. The path of the rays of an electric lantern is clearly marked in ordinary air by the illumination of the motes that float in the air; but if a flask of filtered or otherwise purified air is interposed, no such illumination takes place, and the space inside the glass vessel appears dark. For the same reason, a flask filled with clear liquid transmits the light, acting as a rough lens, while the liquid inside remains dark; but a turbid liquid reflects the light at all ible angles, and appears brilliantly luminous in consequence. The beam of light is therefore a test, not only for solids floating in the air, but also for solids floating in liquids; and as turbidity is an invariable consequence of the establishment of putrefaction or fermentation in a liquid, the use of the test is obvious.

So far the experiments, though interesting and suggestive, brought out no new truth. That floating particles existed in the air, that they were partly organic, and that they could be removed more or less completely by filtration through cotton-wool, were facts known before; and the correlation of these facts with the current theories of putrefaction, fermentation, and zymotic disease was obvious. The agency of the air in these processes was doubted by few; and the idea that the solid particles of the air were the active agents in them, was entertained by many. It remained to connect by direct evidence the solid particles and the zymotic changes, and to prove that when the solid particles were excluded, the zymotic changes did not occur. As far as putrefaction is concerned, this direct evidence has been supplied by the experiments we are about to describe.

An air-tight wooden box was made, of which one side was glass, while each end had a glass window through which the beam of light could pass. Through the bottom passed several test-tubes, sealed in their holes, and with their open ends upwards. In the top was an india-rubber stuffing-box, through which passed a long pipette by which liquid could be dropped into each test-tube in turn. The inside of the box was moistened with glycerine, so that all particles that settled on it might be retained. Alterations of volume were provided for by small tubes, plugged by cotton-wool at the top. So prepared, the apparatus was allowed to remain at rest for three days, until by the passage of a beam of light through the windows, the freedom of the inclosed air from dust was proved. Then organic solutions of various kinds, infusions of turnip, and of many kinds of fish, flesh, and fowls were dropped into the tubes. If our memory serves us rightly, about one hundred and thirty different

infusions were used in turn. The liquids in the tubes were then boiled from below for five minutes, and the apparatus was placed in a room maintained at a suitable temperature. Similar experiments were made in atmospheres purified by filtration, and by calcination; but in all the results obtained were identical. Except in a few cases, where the cause of the failure was certain and obvious, no turbidity occurred, and no organic life was developed in one single sample, even after the lapse of weeks or months. Every one of the same solutions, when exposed to ordinary air, putrefied rapidly.

It is difficult to see any flaw in the evidence here presented. The conditions were apparently far less stringent than in Dr. Charlton Bastian's experiments, and the aptness of the solutions for putrefaction was proved in each case. The only obstacles to the spontaneous generation of bacteria were the five minutes' boiling and the purification of the air; and yet these obstacles were in every case sufficient. It seems, however, that the advocates of heterogenesis are by no means content to accept these results as final and conclusive. — *Lancet.*

A German Torpedo-Boat.—The German papers announce the launching of the "offensive torpedo steamer" *Uhlan*, from the Stettin Engine Company's Docks. This vessel will receive a torpedo charged with dynamite, to be carried on a 10 ft. ram lying deep under the water-line, which torpedo is to explode on contact with the hostile ship. To protect the torpedo-boat from the results of the discharge of its own torpedo, the vessel is built with two complete foreparts, sliding one within the other, and having a considerable extent of intermediate space between them. This space is filled with a tough and elastic material (cork and marine glue), and thus, even if the bows were carried off, there would be a second line of resistance. The object of the filling is to act like a buffer, deadening the blow, and protecting the stem. Another striking feature is the great power of the engines, the *Uhlan* carrying an engine of 1000 indicated horse-power. The steam is supplied by Belleville's tubular generator. The vessel, in fact, is all engine, only a very small space being left for coal and crew. When the *Uhlan* enters upon action, the dynamite cartridge is to be fixed by divers at the point of the ram. The rudder is then to be fixed, and the crew are to open a wide port on the ship's side, and with their raft jump into the water. The steamer is then allowed to rush forward, and burst its cartridge on the enemy's armour. The crew, however, are to hold on the torpedo-boat by a line, whilst they are awaiting the result of the explosion, and in case their boat is not hurt, they are to board it again, in order, if necessary, to repeat the manœuvre. The price of this torpedo-boat is about 30,000*l.*

Rates of Motion.—A French scientific journal states that the ordinary rate of a man walking is 4 feet per second; of a good horse in harness, 12; of a reindeer in a sledge on the ice, 26; of an English racehorse, 43; of a hare, 88; of a good sailing-ship, 14; of the wind, 82.

A Curious Japanese Compass.—In *Land and Water* Mr. Frank Buckland lately drew attention to a remarkable compass which Captain J. H. Murray, of the screw steam-ship *Scaresbrook*, obtained from a Japanese pilot at Yokohama, in 1874. It had been taken out of the wreck of a junk which had been lost on the island of Vries, a volcanic island at the entrance of Yokohama Bay, the smoke of which, with the snow-capped peak of Fusiyama (the sacred mountain of

Japan, or the mountain of Fire—mana, a hill; fusi, fire) indicates the entrance to the harbour. The pilot could give no information about the compass, except that it was found on board the wreck. It is of a circular form, measuring 13½ ins. across, cast in bronze, and weighs 21lbs. It has a thick rim, in which two ordinary compasses are set, one on each side. The centre of this remarkable plate-looking object is considerably raised from the surface, and is covered with a number of raised spots or stars of various sizes, each more or less connected by lines with its neighbours. The shapes of these star-like objects are remarkable; in the centre there are five which are larger than the rest. Then there is another group very like a net; another group represents almost a complete circle of these stars; another represents a Y with the arms closed together; another a Y with the arms extended. Altogether, there are no less than two or three hundred of these elevated spots of different sizes. Running throughout the whole series are several lines radiating from a circle drawn round the centre. The brass rim on which the compasses are set is divided into 360 degrees, the same as an English compass. At every thirty degrees there is a Japanese character. It is most interesting that these rude characters should be united in the same instrument with the 360 degrees of modern civilisation. The casting of this remarkable instrument is very marvellous. An optician who cleaned it up for Captain Murray in Glasgow, said he had never seen a finer bit of work.

The Volcanic Phenomena and Earthquakes of 1875.—Among the numerous eruptions of the year 1875 those in the northern island (of Iceland) seem to have been the most important. As, however, they occurred in wholly uninhabited regions, and only a few individuals penetrated, with great labour and trouble, to the neighbourhood of the phenomena, they have been less known than they deserved to be. It is certain that from the beginning of the year, on to September at least, ten eruptions occurred there, in various parts, mostly from newly-formed craters in the neighbourhood of Vatna. Although this volcano remained quite inactive, the outbreaks were probably from its centre, and only in consequence of local conditions made new paths for themselves. The most violent occurred from January to the middle of February; then on March 29th, when the reflection of the fire could be observed even in Reykjavik, and the ashes were carried by winds over the ocean to Norway, and far down into Sweden; then on August 15th, when volcanic masses were thrown out from more than twenty apertures of eruption.

The Ceboruco in Mexico, which a short time ago, by its first historic eruption in 1870, entered into the series of known volcanoes, had on February 11th, 1875, another great outbreak. The terrible earthquakes accompanying it overthrew the towns of St. Christobal and Guadalaxara.

Considerable, but less known eruptions took place from the Mauna Loa on August 11th (from the highest crater Mokuaweoweo), from the Javan volcano, Kloët, in February, and from Tonyariro, in New Zealand, in the last months of the year. Vesuvius and Etna remained comparatively quiet. The former became weakly active in December—an earthquake announcing the fact beforehand—and accumulated fresh lava in the crater, without, however, the eruption taking place, which Palmieri feared. In Etna, on to November, there were only a few earth vibrations;

towards the end of the year, however, a crater on the south slope of the hill became lively, and the fire-glow illuminated as far as Acireale.

The ninety-seven earthquakes known to me occurred on a hundred different days, and consisted of a great number of more or less violent shocks and numerous earth vibrations. There were among them many very violent earthquakes, which wrought extensive mischief. The most terrible was that of Cucuta, in New Granada, where, from May 16th to 18th, through the numerous powerful earth shocks, several towns and many country houses were completely ruined, and desolation was wrought over a wide region. The loss of human life was estimated at 16,000. Among the great earthquakes may be reckoned those of St. Christobal on February 11th; of Lifu on March 28th; of the Loyalty Islands; of Uschak, in Asia Minor, on March 3rd to 5th, and on 12th; of Lahore, in India, on December 12th, and of Porto Rico on December 21st. In all these earthquakes many people lost their lives.

The entire number of earthquakes is thus distributed in the various seasons:—Winter, 34 (January 15th, February 7th, December 12th); Spring, 28 (March 12th, April 7th, May 9th); Summer, 21 (June 10th, July 6th, August 5th); Autumn, 14 (September 3rd, October 2nd, November 9th).

While many of these earthquakes stood in remarkable connection with the action of volcanoes, others were as distinctly of a non-volcanic nature. A phenomenon which occurred on April 28th, at Kattowitz, in Upper Silesia, deserves special notice. On the day referred to a considerable earthquake was perceived over a wide district, but especially in Königshutte. The cause of it, as afterwards appeared, was the tumbling together of some undermined strata 250 metres under the surface. The phenomenon shows what actions produce those mechanical movements in the earth's interior, which contribute to the manifold changes in the architecture of the body of the earth. Where the occasion, as in this case, is given by human operations, one avoids, in ordinary talk, the expression "earthquake." Those actions, however, which are produced by similar processes, without the co-operation of man, either by the action of water, or by chemical processes, or by purely mechanical alterations of the equilibrium of particular portions, form a large part of the earthquakes of each year.—*M. Fuchs in Der Naturforscher.*

A Real Ice-Rink.—Although for several years past the notion of a real ice-rink has existed on paper and in the minds of several inventors, it is only of late that the idea has been realised, and that the theory has passed into practice. On a plot of land behind the old Clock-house in the King's-road, Chelsea, and forming part of what was formerly Queen Elizabeth's nursery-ground, and on which still exists a mulberry-tree said to have been planted by that Queen, is situated the Glaciarum, the real ice skating-rink. This rink is the result of Mr. John Gamgee's long and persevering labours to produce artificial cold at a low cost.

Mr. Gamgee began his work in connexion with the present rink at Chelsea a considerable time since, and in 1874 he designed a rink in which the ice was carried on an iron plate or floor supported on iron girders, which rested on a floor of wood, and this on a concrete bed. The spaces between the girders, the wood, and the iron plates served as conduits for the freezing liquid. This form, however, he subsequently improved upon until he so far perfected his designs as to produce the rink which

we recently visited, and on which several noblemen and gentlemen—members of the London Skating Club—were skating with expressed satisfaction.

Situated at a short distance from the rink is the machinery house, wherein the primary agents of congelation are at work. These consist, first, of a steam-engine, which drives an air pump, the function of which is to keep a few gallons of ether—only four, it is stated—in constant circulation. This ether is the means whereby the refrigerating liquid is kept at the temperature necessary for doing its work. The ether is first placed in the refrigerator, which consists of a copper casing about 5 ft. square, and having a number of vertical tubes inserted in it. The refrigerator is placed in a wooden tank which just contains it, and in which it is surrounded by the cold-transmitting liquid, the ether being inside the copper casing. As the ether vapourises it produces intense cold in the refrigerator, and as it does its work it is exhausted by the pump from the refrigerator and forced over into the condenser, where it liquefies, the latent heat becoming sensible heat and being transmitted to and extracted by the water of the condenser. This apparatus is somewhat similar in size and appearance to the refrigerator, except that the metal casing has a number of copper tubes placed horizontally instead of vertically, and that these tubes are double—that is, one within the other. The cold water flows through the inner tube and outside the outer tube, the ether passing through the annular space between the two tubes, and being there liquefied. From the condenser the ether flows back to the refrigerator, thus being constantly kept in circulation, and suffering theoretically no diminution, and practically, it is stated, but very little.

We next come to the liquid used for producing and preserving congelation, and this is a very special feature in Mr. Gamgee's arrangement. Mr. Gamgee uses a mixture of glycerine and water which is practically uncongealable, and which acts as a preservative of the metallic portions of the apparatus. Pure glycerine, it is true, freezes at a temperature of 12 deg. Fahrenheit if slightly agitated, but the aqueous solution employed by Mr. Gamgee remains uncongealed at a temperature below zero. To this fact the main success of the rink is due. This aqueous solution is placed in the refrigerator at starting, and after being brought down to the required temperature, which is between 15 deg. and 25 deg. below the freezing-point, it is pumped gently up into a store tank placed about 10 ft. above the ground. From the tank the liquid flows by gravitation through about 55 ft. of pipe to the rink. It then traverses the series of tubes embedded in the ice, and returns, still by gravitation, to the refrigerator whence it started, to be pumped up over again into the tank. Here, then, we have a second circulating system, perfect in its arrangement, and no less perfect in its working and results.

During the course of the day ice dust has occasionally to be cleared off the rink. This dust is taken to an auxiliary refrigerator, where salt is mixed with it. This refrigerator is placed at the head of the larger one, and the pipe through which the cold-transmitting liquid returns to the latter passes in a coil through the former, and the liquid is here reduced in temperature, the economy of the process being promoted. This completes the ingenious arrangements for producing the real ice rink. Although the machinery is not in duplicate, no fear of the stoppage of skating from a breakdown is to be apprehended, as the only accident that apparently

could happen would be to the pump valves, an accident which could be repaired in a few hours. During that time—in fact for 48 hours—the rink could be maintained in a proper condition by reason of the large quantity of cold-transmitting liquid in use. If all were pumped into the upper tank it would circulate and do its work for 48 hours without the aid of the refrigerator and condenser, or, in other words, independently of the ether.—*Times.*

Twins.—What may be termed the socio-physiological aspect of twins has received, up to the present time, little attention. The occurrence and the characteristics of twin-births—so strange an anomaly among animals which usually produce but one at a birth—have been abundantly investigated in their more directly physiological aspect. But the life-history of twins, their personal characteristics, their relations to external circumstances, have not hitherto received comprehensive study. We are therefore glad to direct our readers' attention to an interesting article on the subject in the November number of *Fraser's Magazine*. Mr. Francis Galton has extended to this more special point means of investigation which he has employed on a wider scale to ascertain the influence of hereditary and other conditions upon mental culture. His object in the investigation has been to compare, under similar circumstances, the respective influences of nature and of nurture, of inborn tendencies and of external influences. He has endeavoured to ascertain the effect of diverse training upon twins who in early life manifested a striking resemblance, and, on the other hand, the influence of similar educational circumstances upon those who were at first dissimilar. His materials were obtained by sending out circulars to twins, or to those who were the near relations of twins; and the answers to his queries have furnished him with a series of facts, apparently well authenticated, which, if they have led to no new discovery, at least illustrate very fully the conclusions which had before been reached from isolated observations.

The cases of which details were obtained ranged themselves into three clases—one in which twins presented strong resemblance, another in which they were moderately alike, and a third in which they were strikingly dissimilar. Eighty instances of the first class were met with, of which thirty-five presented instructive details. In a few cases the parallelism between the twins was complete, and in many others the physical resemblance was so close that the most intimate associates were puzzled to distinguish one from the other. Of the mistakes made under the circumstances Mr. Galton's pages contain some very curious instances, and many anecdotes are authenticated in which one twin had been fed, physicked, or whipped in mistake for the other. In one case, indeed, a doubt still remains whether the children were not changed in their bath, and the presumed A is not really B. In another instance an artist was unable to identify, with the originals before him, the likenesses he had partially completed. Facile impersonations are very frequent, one twin replacing the other for a lesson, a punishment, or a dance, without discovery; and no less than nine accounts are given of one twin seeing his or her reflection in a looking-glass and addressing it as his twin. Even in adult life such mistakes have occurred not unfrequently.

A comparison of these cases shows how little visible effect external influence has had in determining divergence in character or physique. As a rule, resemblance at birth has entailed resemblance through life, even

where the external conditions have been remarkably diverse. A profound physical change, entailing often permanent and complete alteration of mode of physical life, has alone sufficed, in most instances, to effect an apparent divergence of development, and even then the resemblance beneath the dissimilarity could often be traced in identical characteristics. On the other hand, in no case of initial dissimilarity was any marked resemblance produced by the most perfect correspondence of surrounding circumstances, lessons, changes, &c. In no case did identity of nurture override and assimilate diversity of nature, and in no case did diversity of nurture produce an essential difference between those naturally alike.

Of more immediately medical interest are the facts which Mr. Galton has obtained illustrative of the frequent identical relations of twins to disease. These facts corroborate very strongly the paramount influences of physique and heredity. The close resemblance of physical condition, which amounts, in many cases, to a practical physical identity, renders twins liable to be affected in an identical manner by common influences to which they were exposed. Contagious diseases, accordingly, nearly always affect twins simultaneously who are together. Diseases which are not contagious, but depend on external circumstances of very uncertain effect, frequently attack twins at the same time. Asthma and ophthalmia are instances of this, of which examples are cited from Trosseau. Still more striking are the examples in which diseases which can scarcely be said to be related to external conditions—diseases which, at any rate, are mainly the result of internal predisposition—occur at nearly the same time in twins. Mental derangement affords a striking illustration of this, of which some remarkable instances have been collected by Mr. Galton. In another case, two twin brothers died at almost the same time of Bright's disease.

Most of the cases in which differences appeared, as development progressed, between twins at first alike, were determined by a physical influence. In some cases this was a condition which led to a total change of external circumstances. In others it was a mere physical illness, which effected no such change of external condition. In four cases it was scarlet fever, in one typhus, and in one a "nervous fever." The profound effect on development which such influences occasionally produce is well known to physicians, but has hardly before been brought out by so delicate a test as the opportunity for comparison afforded in these cases. It is evident that Mr. Galton has obtained many facts of great interest and importance, and we hope he may pursue his investigations still further in the same and allied directions.—*Lancet.*

On Force.—During the meeting at Glasgow of the British Association Professor Tait delivered a lecture on the above subject. The lecturer said that at such short notice it was not to be expected that he could produce a discourse which should commend itself to the Association by its novelty or originality, but that in science there were things of greater value than even these—viz., definiteness and accuracy, without which, in fact, there would be no science, except that peculiar smattering which was usually called, he hoped untruly, "popular." Nothing beyond the elements of science could ever be made, in the true sense of the word, popular; but it was the people's right to demand of their teachers that the information given should be at least definite and accurate so far as it went, and as a teacher of science could not do a greater wrong to his audience than

to mystify or confuse them about cardinal principles, so wherever there appeared to be such confusion it was the duty of every scientific man to endeavour by all means in his power to remove it. Some criticisms on works in which, he said, he had at least had a share, had shown him that even among the particularly well educated class who wrote for the higher literary and scientific journals there was wide-spread ignorance as to some of the most important elementary principles of physics. He had therefore chosen as the subject of a lecture a very elementary but much-abused and misunderstood term which was met with at every turn in the study of natural philosophy.

If one had a right to judge of the general standard of popular scientific knowledge from the statements made in the average newspaper, or even from those made in some of the most pretentious of our so-called scientific lectures, there could be but few people in this country who had an accurate knowledge of the proper scientific meaning of the little word "force." There was no reason to object to such phrases as "the force of habit," "the force of example," &c.; but when they read in one newspaper that "the force of a projectile from the 81-ton gun had at last reached the extraordinary amount of 1,450 feet," in another that "the force" of a ball from the great Armstrong gun made for the Italian Government averages somewhere about 30,000 foot-tons, and in a third that the water in the boiler of the *Thunderer* "would in a second of time generate force sufficient to raise 2,000 tons one foot high," they saw that there must be somewhere at least, if not everywhere, a most reckless abuse of language. They had come to what ought to be scientific statements, and in such even the slightest unnecessary vagueness was altogether intolerable.

The lecturer then showed how the incorrect physical ideas of Leibnitz and some of his followers had introduced the terms *vis viva*, *vis mortua*, and *vis acceleratrix*, and that these in many other shapes still disfigured the physical terminology of most European languages, especially the German and French, but that an effort had recently been made to introduce similar or even greater confusion into our own language.

After some general observations on our modes of acquiring information of the physical world, and after many remarks tending to the inculcation of caution in interpreting the direct evidence of our senses, the lecturer proceeded to state that the notion of "force" was suggested to us by the so-called muscular sense, as in the effort to overcome a resistance or to move an obstacle. He illustrated this by many references to sound, light, heat, and pain as distinguished from the motions of the air, ether, and the cricket-ball or cudgel, which produced these sensations.

Recent experimental science, completing a wonderful forecast of Newton's, had, in the hands first of Rumford and Davy, and quite recently of Colding and Joule, given us the complete proof of the objective reality of what is called "energy." Energy, in fact, was now known to have as much claim to objective reality as matter itself. But while matter, as far as we know, was incapable of undergoing transmutations, energy, on the contrary, was of use to us solely in virtue of its transformability, and whenever energy was transformed there was always relative motion of at least two masses or systems of matter. The rate of transformation or transference of energy per unit of length in such motion was for the present very usefully called "force." But what the lecturer had already said about the

untrustworthiness of the direct impressions of our senses showed that "force," though suggested to us directly by the muscular sense, was in all probability a mere term like "three per cent." which was not a sum of money; or like "birth-rate of the country," which was not a group of living children. "Three per cent." and "the birth rate" were exceedingly useful aids of calculation and statistics. "Force," then, had no more objective reality than had the birth rate of a country.

The lecturer then quoted Newton's laws of motion, and showed what was, according to Newton, the definition of force—that all forces, whatever be their sources, were measured by one and the same unit. They were measured by the amount of momentum which they could produce in a unit of time. There was no special law for gravitation force, and others for electric and magnetic force; all were defined and measured alike, without reference to their origin. This of itself was one very strong argument in favour of the non-objective existence of "force."

The lecturer concluded by drawing attention to the more objectionable sources of the present confusion and error, and concluded thus:—When I find men who make these blunders in a science where at least in the elements accuracy is not only indispensable but easily attainable, when I find these men unsettling by vague and altogether unscientific speculations the cherished beliefs of their fellow men on matters of unutterably greater moment, I conceive that I am morally bound in season and out of season to take every possible opportunity of showing the true value at which to estimate their scientific authority. In defence of accuracy, which is the *sine qua non* of all science, we must be zealous, as it were, even to slaying, and as all the power of *The Times* will not compel us to put a "y" instead of an "e" in the word "chemist," so neither will the bad example of Germany and France, though recommended to us with all the authority which may be attributed to an ex-president of this Association, succeed in inducing us to attach two or more perfectly distinct and incompatible scientific meanings to the useful little word "force" which Newton has once and for ever defined for us with his transcendent clearness of conception.

Sleep and Dreaming.—Prof. Ferrier, early in 1876, delivered two lectures at the London Institution on sleep and dreaming. He commenced his first lecture by stating that periodical rest was a necessity of human life, and that even the amœba, the smallest of our life-germs, required rest as much as the brain or other organs. It might be said that the heart and lungs were exceptions to this rule, and were in a state of constant activity, but, so far was this from being the case, that these organs, in the pauses of respiration, rested fully one-third of the twenty-four hours. The action of life might be compared to the burning of a fire, for during the period of wakefulness there was a constant waste of life material, and sleep was required for the purpose of clearing away the cinders and ashes, and of accumulating fuel for the next day's combustion. Children, whose tissues were being built up, as it were, required more sleep than adults; and aged people, whose tissues were undergoing a process of rapid decay, more than those of middle life.

Anything which tended to withdraw the circulation of blood from the brain was calculated to promote sleep, and hence it was that during the process of digestion, when a large quantity of blood was diverted to the stomach, most people felt an inclination to sleep. This was the philosophy of "night-caps" or hot

alcoholic drinks immediately before bed-time, as also of warm footbaths, which diverted the circulation from the brain to the stomach. Deep thought was an enemy to sleep, because it had a directly opposite effect, and created a morbid activity of the brain. Professor Ferrier mentioned several interesting examinations made by himself and others of the brains of animals and men when asleep as proofs that when unaffected by dreams the brain is quiescent during sleep.

The second lecture was devoted to dreaming. Sleep, he had shown, was the repose of the brain as the organ of consciousness, and sound sleep the cessation of conscious activity. He set aside as unsound the doctrine of Sir W. Hamilton, who from the phenomena of dreaming had argued the continuousness of consciousness during sleep. The brain, though a unity, was a complex unity, and to different parts different functions belonged. Hence, according to the analogy of the bodily functions, one part and its function may rest while others are in action.

The partial activity of the brain was the explanation of dreaming. Conscious activity belongs to the hemispheres proper of the brain. The parts below, in so far as they are independent, are concerned in actions described as reflex, sensimotor, &c., and these can go on as well during sleep as in our waking hours. Diagrams of the brain were referred to in illustration. The brain was the organ of consciousness, and it therefore—not the ganglions of the nervous system, as held by Dr. Carpenter and others—was the organ of sensation. The phenomena of hemi-anæsthesia were cited in proof. For each class of impressions there were special regions of consciousness in the brain. The lecturer was even disposed to localise attention and the higher intellectual faculties. The impressions received were photographed on the brain, and were capable of being revived. But for this power of recalling them no knowledge would be possible. Memory, or the registration of sense impressions, is the ultimate basis of all our mental furniture. Each piece of that furniture has its function like the letters in a compositor's case. We have a sight-memory, an ear-memory, &c. When thinking, or engaged in ideation, we are but re-calling, as shown by Herbert Spencer and Bain, our original sensations and acts of cognition. Some move their lips when thinking as though summoning up the names for their former sensations.

Commonly the reproduction was very faint, but in some instances it was nearly or quite as vivid as the original sensation. It was so with Goethe and other poets, with painters, religious enthusiasts, and with those called spiritualists. It was so also in delirium and mania, and there was always something morbid about such cases. The auditory phantoms of musical composers and others were spoken of. The impressions made on taste and smell were not often so vividly reproduced, but it was otherwise with those of touch.

The relation between visceric euphoria or dysphoria was next illustrated, and the laws of association of ideas, as laid down by Laycock and confirmed by Dr. Carpenter. The nature of this association will vary as individuals, but if the man be known as well as the general laws, it will be possible to read his thoughts. Here the lecturer read a striking extract from E. A. Poe ("Murders in the rue Morgue,") which was received with loud applause. The foregoing principles were then applied to dreaming. In accordance with the laws laid down those portions of the brain most continuously in action would require the longest rest. Hence the centres of attention would sleep while the

functions allied to reflex actions would more easily waken.

The brain in sleep was compared to a calm pool in which a stone causes ripples liable to interruption by other ripples similarly caused. So the ripples of ideation get confused. But, again, the circle on the pool may not be interrupted, and then the ideation will be regular. The current of ideation may be coherent or incoherent. The most vivid association, which is commonly the latest, dominates over the rest. Dr. Reid, the metaphysician, dreamt of being scalped by an Indian. There was a blister upon his head. Dr. Gregory, through having a hot-water bottle at his feet, dreamt of walking up the crater of Ætna. A troublesome corn makes a man dream of serpents biting his foot, and a ringing in the ears has caused dreams of marriage bells. The blue devils and other horrors seen by the victims of *delirium tremens* were analogously explained. Visceral conditions were shown to be most frequent sources of dreams. The hungry dream of feasts, the thirsty of water, and the dropsical of drowning.

From the condition of the digestive organs arose nightmare. Mental or bodily dejection shows itself in oppression of the chest, and this, *vice versâ*, causes mental or bodily depression by the law of association. We feel a hideous animal sitting on us. The oppression leads to an effort at liberation, and we wake from nightmare with a scream. Bereavement makes us dream of our lost ones, and we see them so vividly that our dreams become real apparitions. Incoherent dreaming, in which the currents of ideation get jumbled together, was happily compared to the changes produced by the shaken kaleidoscope.

It was remarked that there is never anything absolutely new in our dreams; we never dream of anything of which our senses are wholly ignorant. The blind do not dream that they see, nor the deaf of music. Here a letter is missing from the fount of type. Our fancy in dreams is awake, and the faculties which should check it are asleep. Hence we are wont to say that nothing surprises us in sleep. The lecturer proceeded to shed light on such facts as that problems have been solved by mathematicians in their dreams which had utterly baffled them when awake. So, the poet Campbell excogitated in his sleep the celebrated sentence, "For coming events cast their shadows before." One beautiful illustration the lecturer used. The brain, he said, might become a palimpsest, the effaced writing on which often reappeared. Past impressions were imperfectly rubbed out and the present written over it, but past memories would revisit us in our dreams, if not in our waking hours. Of the tenacity of memory, a marvellous illustration was cited from Trevelyan's "Life of Macaulay," who picked up while he was waiting in a Cambridge coffee-house for a postchaise, a country newspaper containing two poetical pieces, one "Reflexions of an Exile," and the other a "Parody on a Welsh Ballad." Macaulay looked them once through, and never gave them a further thought for 40 years, when he repeated them without the change of a single word.

Air-bags for Raising Sunken Vessels.—Air being seven hundred times lighter than water, a bag made of a very light water-tight material, when filled with air affords easy and powerful means wherewith to raise sunken bodies. Air-bags are convenient for stowage and transport, because when not in use they occupy very little space, while at the same time when wanted they can be expanded into large dimensions. The greater the weight of the body to be lifted by means of air-bags, the larger of course must be their displace-

ment, and as the bags are generally manufactured of certain fixed dimensions, the weight of the submerged body must determine the number of air-bags to be applied.

The first to suggest the use of air-bags for this purpose was Professor St. Claire, of the University of Edinburgh, who proposed them in the year 1785. But as the india-rubber industry was then but barely developed, air-bags could not then have been manufactured of that material so as to be of practical use. So recently as in 1864, air-bags were for the first time practically applied by Bauer for raising the steamer *Louis*, which sank in the Lake of Boden. But on that occasion, owing to the bags being pear-shaped, they could not sustain the pressure and gave way. The idea of using the air-bags in Russia originated with M. J. Alexandrovsky, and the system was adopted in 1865 at the time when the turret ironclad *Smertch* foundered in the Baltic Sea. Mr. Alexandrovsky was supported by Admiral Popoff, of the Russian Imperial Navy, who assisted him greatly in bringing his invention into practice, carrying out experiments so as to render the air-bag system what it now is—namely, a very valuable means of raising ships, &c., and which has already rendered good service to the government and commerce of Russia on several occasions.

The air-bags adopted in the Russian navy when inflated are of cylindrical form, measuring 12 ft. in diameter, and 20 ft. in length. The useful part of their displacement or their lifting power in practice averages 60 tons. Air-bags measuring 15 ft. in diameter and 20 ft. long will lift about 100 tons, and cost, according to the number required, from £375 to £350 each in St. Petersburgh. The skin of the bags, of the sizes mentioned, is composed of three layers of the thickest canvas, saturated with india-rubber. Between each of the canvas layers is a sheet of india-rubber. The two inner layers of canvas are made up of strips sewn together along their edges, and laid in the direction of the length of the bag, while the third or external layer is made of canvas strips surrounding the bag circumferentially. The strips of this last layer thus cross those of the layer underneath it. This arrangement of the skin layers secures in the bags the required amount of resistance and durability. The external surface of the bag is fitted with special straps through which it is surrounded with a close, strong rope net, which increases the strength of the skin, and a layer of matting is interposed between the skin and the rope net.

In order to distribute over the whole surface of the bag the strain to which it is subjected when lifting heavy bodies, the bag is enveloped in a series of longitudinal and transverse or circular hempen cables. To the lower ones iron eyes are fastened, which afford means to connect the chains securing the bag to the object to be raised. When necessary an oak beam 12 ft. long and 14 in. or 16 in. square is attached to the cables which surround the bag transversely; and to this beam the connecting chains are made fast. Each of the air bags is fitted with a valve, which is screwed in at the top and in the centre, together with an india-rubber hose, by means of which air is forced into the bag. At the ends of the bag, also in its upper part, are two smaller valves with tubes intended for letting the air out, and for holding the pressure gauge, which is applied for the purpose of ascertaining the amount of pressure inside.

In the interior of the bag, along its bottom, two short lengths of hose are sewn in so that they cannot move laterally. One end of each of these pipes which is open termi-

nates close to the end of the bag and in the interior of it, whilst the other end passes out at the opposite end of the bag at the bottom, and is fitted with a safety valve, which opens when the bag is fully inflated with air and the pressure begins to exceed the surrounding water pressure. By means of these two safety pipes and valve the bag is secured from bursting, and the pressure of the air within it distributes itself evenly in both ends of the bag. The bottom part is fitted with a manhole sufficiently large to admit the entrance of a man for inspecting the interior of the bag and for repairs.

In order to lift the sunken vessel, it is necessary first to send down divers to examine her condition, and to find the spot where it would be most convenient to pass chains or cables underneath her keel. For this last purpose the divers at first pass a thin rope underneath the bottom of the vessel, which is followed by a rope of greater thickness, attached to the first and terminating at the other end by a chain or the cable. It sometimes happens that the power of the divers below, and that of the windlasses above, though sufficient to draw a thin rope under the vessel, are insufficient to haul a thick cable. In such cases an air-bag is attached to the end of the thin rope, and this bag being inflated, acquires an ascending power sufficient to carry with it a cable of any required thickness. This method was successfully adopted when a vessel, sunk in a depth of 15 fathoms, was being raised, and when the power of 200 men with windlasses proved to be insufficient to draw the chain underneath the vessel.

When several chains have been drawn underneath the bottom of the ship, the air-bags are attached to the ends of each of them, as near to the bottom of the ship as possible. The bags being inflated by means of air-pumps, cause the ship to rise. Before pumping air into the bags, care is taken to connect together all the chains which surround the hull of the vessel in a transverse direction, so as to form a longitudinal continuous belt, which uniting all the chains into one system, prevent the end pairs of air-bags sliding off from beneath the extremities of the vessel. As the ship rises, the surrounding water pressure decreases, and the excess of air passes out from the bags through the safety-valve, with which each air-bag is provided.

This method of raising vessels and other sunken bodies by means of air-bags, is of very great importance, especially when the work has to be performed in the open sea, because, in rough weather, the bags without any air in them, can be left under water with buoys to mark their position, until the weather becomes more favourable, and the sea calm.

When lifting vessels from great depths, the work must not be accomplished by one process—that is, the whole number of air-bags required to complete the work should not be applied to the ship at one time. This precaution is necessary, because, when the vessel, tied up with chains and provided with the full number of air-bags, ascends rapidly from a great depth and gets to the surface of the water, it is raised, by means of its acquired momentum, higher than is consistent with equilibrium at the surface. Eventually after obtaining an unbalanced position, the whole is submerged again. This arises from the circumstance that from the moment the ship leaves the bottom of the sea and during her ascent the surrounding water pressure is gradually decreasing and the air from the bags is passing out. Therefore at the time when the vessel reaches the surface of the water, the bags do

not possess the amount of lifting power necessary to keep her on the surface. Accordingly the ship would return to the bottom. To prevent this, one, two, or three, and in some cases four bags (according to the size of the vessel), out of the whole number required, are fastened to the chains, which surround the vessel, not close to her, but at a depth of some two or three fathoms below the surface of the water. By such distribution of lifting power, the vessel having separated herself from the bottom of the sea, would ascend until the upper bags reached the surface of the water. The whole system is then towed to another place, where the water is shallower than where the wreck occurred. The air-bags which reached the surface of the water at the first operation are again submerged and are tied to the chains several fathoms lower down. By repeating these operations several times, according to circumstances, the ship will be brought to the surface gradually and by easy stages with the certainty of success.

These precautions are also necessary in those cases when, as it sometimes happens, the sunken ship, after having separated herself from the bottom of the sea, would be raised not horizontally, but with one end higher than the other. By having several air-bags, out of the whole number, attached at a depth of a few fathoms below the surface, it insures that the rise of the higher end of the vessel will be limited only to the height equal to those few fathoms, and the chains with the air- surrounding the ship cannot slide from underneath her. This method of working affords a sure means of ascertaining whether there is any necessity to increase or decrease the lifting power at either extremity of the vessel.

Artistic Doings in Coloured Glass.—Owing to improvements in glass-making, and notably in the manufacture of coloured glass, there is now placed before our modern glass-stainers a complete palette of every colour in nature. Thanks to some of the leading manufacturers, artists need no longer narrow their ideas to primitive and secondary colours, but such delicate gradations of shade may now be obtained that every varied tint of nature may be faithfully reproduced. Full advantage of this state of things has been taken by the leading London firms, many of whose latest productions, both in ecclesiastic and domestic work, demand high praise. We may say the same of some Scottish houses: Messrs. Adam and Small, of Glasgow, for example, have recently attracted considerable attention by their very successful efforts to produce effects which breathe the true spirit of the old masters of the glass-staining art, whilst taking full advantage of modern improvements in glass-making.

The Victoria Institute.—From the Annual Report of this Society for 1876, we learn that it continues to make very gratifying progress. The average increase of members and associates during the past five years has been upwards of one hundred annually, and the actual number of additional names has slightly increased each year. The total number of members and associates in the latter part of 1876 was, we are informed, no less than seven hundred and thirteen: in 1871 there were only two hundred and one. The leading object of the Society, it cannot be too widely known, is to investigate fully and impartially the most important questions of philosophy and science, but more especially those that bear upon the great truths revealed in Holy Scripture, with the view of reconciling any apparent discrepancies between Christianity and science.

Chinese Proverbs.—There is a

touch of the homely and the practical in the great mass of Chinese proverbs:—

"Brothers in the morning, enemies at night."

"A man known well is a treasure."

"A prodigal, when he repents, becomes a priceless treasure."

"Every man loves his own skin and flesh."

"If you honour your own parents at home why go afar to burn incense?"

"Out of the broken kiln come very good tiles."

"Stoop not in the melon-field to draw up your boots. Stay not under the plum-tree to adjust your hat."

"If you look before and behind, food and clothing will never be wanting."

Long, Long Ago.—The natives about Lake Tahoe ascribe its origin to a great natural convulsion. Their story is that their ancestors were once numerous and rich, but a stronger people rose up who defeated and enslaved them. Then the Great Spirit sent an immense wave across the continent from the sea, which engulphed both oppressors and oppressed; all but a small remnant. Those who remained of the ruling caste made the people build a great temple for refuge in case of another flood, and on the top of this the masters worshipped a perpetual fire. Soon, however, the earth was troubled again; this time with strong convulsions and thunders. The masters took refuge in their great tower, shutting out the slaves, who fled to the Humboldt River, and paddled for their lives, for the land was tossing like a troubled sea, casting up fire, smoke, and ashes. The Sierra was mounded up from the bosom of the earth, while the place where the great fort stood sank, leaving only the dome at the top exposed above the waters of Lake Tahoe.

Patents in France.—In 1874, there were taken out, in France, 5,746 patents: 4,202 for fifteen years, 54 for ten years, 32 for five years, 383 foreign patents, and 1,175 extensions of former patents. The objects for which patents were taken out were in the following order for number: chemical industry—including food and drinks—machinery, textile industry, agriculture, domestic appliances. The average number of patents per annum, in the ten years before the Franco-Prussian war was 5,800.

Much Show and Little Work.—In his last book Professor Haeckel, the great apostle of evolution in Germany, announces the discovery of the following law:—"In all the magnificent scientific institutes founded in America by Agassiz, the following empirical law, long recognised in Europe, has been confirmed, viz., that the scientific work of these institutes, and the intrinsic value of their publications stand in an inverse ratio to the magnitude of their buildings and the splendid appearance of their volumes." "I need only refer," he adds, "to the small and miserable institutes, and the meagre resources with which Baer in Königsberg, Schleiden in Jena, Johannes Müller in Berlin, Liebig in Giessen, Virchow in Würzburg, Gegenbaur in Jena, have not only each advanced their special science most extensively, but have actually created new spheres for them. Compare with these the colossal expenditure and the luxurious apparatus in the grand institutes of Cambridge, Leipzig, and other so-called great universities. What have they produced in proportion to their means?"—*Nature.*

Improvement in Artificial Teeth.—The most recent improvement in the manufacture of artificial teeth is that of an adaptation of the principle of the common sucker to the artificial palate. The patent suction-valve of Mr. G. H. Jones, of Great Russell Street, is an in-

genious contrivance of great simplicity, by which the upper case of teeth is kept firmly in the mouth, and can only be removed at the will of the wearer. The action is simple, while the effect is most perfect. The tongue easily, and by a natural movement, effectually exhausts the air from the valve, and the teeth are retained *in situ*, upon the principle by which a boy raises a stone by means of an ordinary sucker. This plan obviates the old and somewhat clumsy arrangement of fitting teeth with springs and wires, which frequently require repair, while the perfect contact of the artificial teeth with the roof of the mouth, which this improvement secures, prevents crumbs and portions of masticated food from hanging about the mouth —always a source of discomfort, and tending to produce a foulness in the breath, not only inconvenient to the patient, but which is always a sure indication of the presence of ill-fitting artificial teeth. The improvement thus explained possesses the very important recommendation of rendering the secure fixing of artificial teeth a painless and easy operation. All the inconveniences which patients suffer under other less simple and effective methods are entirely avoided, and the artificial teeth are so firmly held in their place that the power of mastication and articulation is not in the slightest degree impaired.

A New Beverage Wanted.—The ravages of the *Phylloxera* among the vines have caused many attempts to be made to discover a new kind of beverage which might take the place of the juice of the grape. The Marquis de Villeneuve reports that in China a *pseudo* wine, called "Tsien-ia," is much used, which is concocted from a preparation of four plants common in that country, mixed together in certain proportions. The plants are dried and powdered, and made into a paste, which is sold in the form of balls or squares at the rate of about 3*d.* a pound. One ball or square will make several pints of a fermented liquor, pleasant to the taste and much resembling wine: it is much sought after by Europeans and others living in China. A factitious brandy is also prepared in the same way, and the manufacture is so simple that with a capital of £5 or £10, to purchase the apparatus, a man may make twenty-five gallons of "brandy" a day. The Marquis de Villeneuve affirms that the "wine" thus produced is of good quality and possesses no injurious ingredients.—*Nature.*

A Correction.—We hear continually a wrong pronunciation of the Droeshout portrait of Shakspere. The word is Dutch, and should be pronounced *Drooz* (like *ooze*) *howt* (like *shout*). *Droes* means a giant; *hout* means wood, timber, as Hexham says.—*Academy.*

Opium and its Effects.—The three classes of opium are considered by the Chinese as having peculiar characteristics. Bengal opium which is prepared with great care, though having strong narcotic properties, is free from many of the objections which the Chinese aver attach to the others. Malwa is of a stronger flavour, more coarse and biting to the taste. It is said to have a tendency to induce an unhealthy condition of the skin, and is altogether more pungent and stimulating. It produces heartburn in those unaccustomed to its use, and is irritating to the nervous system. Native opium, again, possesses all these bad qualities of the Malwa drug, with others of its own. It is said to be coarser and more fiery than the Indian, its flavour is inferior, and it produces disagreeable and troublesome eruptions of the skin, and it is moreover constantly adulterated to a great extent with seaweed, oil, &c. To remedy these

defects it is said that the smoker is obliged to have recourse to the foreign drug.

The difference between the foreign and native sorts is so marked that the Chinese say that no man can exchange the use of even the inferior foreign drug for that of the best quality native product.—*Journal of the Society of Arts.*

An Artificial Hare.—An interesting experiment was made one Saturday in August, in a field in the neighbourhood of Hendon, with a mechanical hare, the invention of Mr. Geary, a gentleman of considerable experience in sporting matters. The invention has been patented, and its object is to make an artificial hare travel along the ground at any required pace, and so closely to resemble the running of the living animal as to be eagerly pursued by greyhounds. Judging from the result of the experiments, it may be said that the inventor has completely succeeded in his object. The hare having been started at one end of the field, went at a great pace to the other, followed in full chase by a brace of greyhounds, which were completely deceived by its appearance and action, and by doing this not once but in several successive runs made it quite certain that for greyhound racing the artificial hare would serve quite as well as the real one. The hare itself is nothing but the skin of a real one carefully stuffed, and it stands on a carriage somewhat resembling that which gives motion to the rocking-horse. Its motion is effected by means of an open tube, over which it runs, and in which is laid a rope or wire of the length required for the distance to be run. At the far end is a winch of special construction and great power, worked by hand, and by turning this, two men give the hare any speed required. In the front of this machine is a screen of furze, into which the hare runs, and disappears, much to the surprise and discomfiture of the hounds, who are evidently much puzzled as to what has become of their expected prey. The object of the invention is to provide artificial means for greyhound racing (not coursing).

Work and Play for Schoolboys.—Parents who do not wish their sons to be sacrificed to the Moloch of "early success" should jealously scrutinise the prospectuses of the schools to which they send their boys, and if the working hours are found to be excessive, the school should be avoided. As a general rule it may be stated that thirty-five hours of school-work a-week for boys under fourteen, and forty-two hours for boys over that age, is as much as the health and strength can fairly stand; whilst the success that still attends the old public schools, who rarely exceed these hours, show that they are amply sufficient for educational purposes.—*Lancet.*

Gold Mining in Victoria.—We have received from Mr. Richard Gibbs, the Registrar General. of Victoria, an interesting series of "Abstracts of Specifications of Patents applied for from 1854 to 1866." They relate solely to gold-mining, an industry which naturally receives no small share of attention in the colony.

XXVI.—THE EXHIBITIONS OF THE YEAR.

Loan Collection of Scentific Apparatus.—The exhibition of a "loan collection" of scientific instruments at South Kensington was opened by the Queen on the 13th of May. Amongst the most interesting relics, which after all formed the chief attractions to the general public, were Sir W. Herschel's 7ft. telescope, and a 10ft. Newtonian made by him; two telescopes made by Galileo, and several little pieces of apparatus or instruments belonging to the great Italian; Baily's apparatus; a quadrant belonging to Tycho Brahé; a telescope by Huyghens; the pendulum apparatus of Foucault and Gauss; Babbage's calculating machine, and that made by Jas. Black for Lord Mahon. There also was exhibited the original Napier Bones, the measuring instruments of Sir Joseph Whitworth, the apparatus employed by Joule in ascertaining the mechanical equivalent of heat, the apparatus with which Faraday made many of his discoveries, the original Wheatstone Bridge, the instruments used in laying the Atlantic Cable, and evén Armstrong's hydro-electric machine.

We here condense from the *Times* a general summary of the contents of this remarkable collection.

"The educational collections will certainly give our schoolmasters and school apparatus-makers food for much thought. Here Germany and Russia divide the palm, and England is nowhere. The most general collection is that contributed by the Committee of the Pedagogical Museum of Russia, which indicates most clearly that in no country is the value of scientific instruction more appreciated than in Russia.

"On leaving the Educational collections, the objects which strike us on the right and left respectively are Stevenson's 'Rocket' and 'Puffing Billy,' lent by the Commissioners of Patents. These require no comment; but the next objects on the left and right are now exhibited for the first time in England. We refer to a steam cylinder by Papin, bearing the date 1699, sent over from the Royal Museum of Cassel, and a collection of Watt's original models of various parts of steam engines, contributed by Mr. Gilbert Hamilton. The steam cylinder, which was made at Cassel, is almost the only surviving witness of the works of Papin, from which a series of inventions has sprung, which have completely changed in a few decades our modes of life. Newcomen's engine and Captain Savary's engine also find place, as does Bramah's first hydraulic press.

"In the series of rooms devoted to naval architecture and marine engineering, the first object, on the left, is a model of the Faraday, and, after a long line of other models, we come, in the next room, to Mr. Froude's, illustrating his method of ascertaining the resistance of ships by measuring the resistance of their moulds. This method is now used for Her Majesty's ships.

"After the avenue of marine models, we pass through another of lighthouses. Among these, first mention must be made of the magnificent series representing the earliest attempts of Fresnel, sent by the Lighthouse Service of France.

"We have now soundhouses as well as lighthouses, and various arrangements for warning mariners by sound signals, from the portion of the first-class fog-signal exhibited by the Trinity-house, to the Holmes 'Aurora' fog-horn, for use on board ship, are represented; an interesting series of drawings of the arrangements used in the Adriatic coming from Austria.

"The first room in the western galleries embraces magnetism and electricity. These include a most remarkable and interesting collection of original apparatus connected with terrestrial magnetism and the development of magnetic and voltaic electricity, and the application of the electric current in the progressive development of the telegraph. This, perhaps, is the most bewildering room of all, for it is the most crowded, and steam-engines in an annexe are used for driving some machines, not necessarily electrical, for which steam power is necessary. The steam-engine has been placed gratuitously at the service of the Department by Messrs. Ransomes, Sims, and May, and the non-electrical objects driven are M. Pictet's new ice machine, and two machines, the counter-parts of each other in the process of type-setting by mechanism instead of by the hand as heretofore, exhibited by Mr. Walter, M.P. The printer has hitherto composed, or built up, the words and sentences of his manuscript letter by letter, each letter being taken by his fingers from its own compartment in the open case before him; and when the matter thus set up has served its purpose on the press, he has again distributed it letter by letter back into the compartments of his case. The two machines now exhibited by Mr. Walter are samples of what, after four years' practical experience, has been found best adapted to the object of getting printing, or type-setting, done entirely by mechanism. The Composing Machine, with its type arranged in tubes, explains itself. The Type-caster is the form which the new system takes, as the simplest, cheapest, and best way of getting type, on its return from the press, back into the tubes of the Composing Machine.

"In magnetism pure the Teyler Institution at Haarlem contributes one of the largest natural magnets in the world; and M. Jamin has sent over one of his, by which he demonstrates the greater holding power obtained when the magnet is built up of fine laminæ. In terrestrial magnetism are historical dip circles and original recording instruments as well as many useful for magnetic surveys. Dr. Vogel, of the Sun Observatory, of Berlin, has allowed his complete magnetic equipment made by Adie to remain in this country during the Exhibition, and it is to be seen erected near the lighthouse. The subtle laboratory results of Ampère on the attractive and repulsive influence of voltaic currents upon themselves when passing through metallic conductors in the same or in opposite directions; the delicate elaboration by Oersted in 1819 of the directive influence upon a suspended magnetic needle of voltaic currents passed in a direction parallel to its axis, the development of this by Gauss and Weber in 1833; the work of Soemmering in 1809, who first used currents from the Voltaic pile for telegraphic purposes; of Steinheil, who discovered in 1836 the practicability of using the earth as the return circuit; of Seebeck, of Berlin, in 1821, on thermo-electric currents; and the labours and discoveries of Faraday and Wheatstone as regards magneto-electricity and the laws that regulate the transmission of electric currents through metallic conductors, with their practical application to the transmission of intelligence to

distant parts, are all brought before us. The chief interest of the collection in this department, as in others, culminates in the original apparatus. In magnetism, the original apparatus of Faraday which he employed in his experimental researches in the magnetic and diamagnetic character of gases, and in his researches upon the polarity of diamagnetic force are of great interest. The series of voltaic current generators comprise, among others, the original elements which were employed by Daniell, Wollaston, Sturgeon, and Grove in their researches. Some of the earlier forms of the magneto-electric machines by Wheatstone are contributed from the physical apparatus collection belonging to King's College, London. From the same collection is the original apparatus by which Wheatstone determined the velocity and duration of the electric spark by means of a rapidly revolving mirror, and the elongation of the electric spark discharged through a wire half a mile in length, giving an estimated velocity of 288,000 miles in a second. A wonderful series illustrating the evolution of the electrometer contributed by Sir William Thomson must not be passed over.

"The historical collections of telegraphic instruments are of great extent. Here is the original five-needle telegraph of Cooke and Wheatstone, 1838, with its large lozenge-shaped cumbersome dial, and heavy pointers indicating the letters by the convergence respectively of two of the needles, and we here also find the first attempt at the insulation of underground wires, the five metallic line wires required to carry the signals being inserted in grooves cut longitudinally in triangular pieces of wood, filled in with a resinous cement, and laid underground. Here are also the first electric key and relay instrument constructed by Wheatstone, and Cooke's and Wheatstone's early letter dial telegraph of 1840. Passing along the collection sent by Her Majesty's Postmaster-General, the attention is arrested by two large double-needle instruments in heavy mahogany cases, bearing brass inscription plates at their base. These two instruments, contributed by Messrs. Reid, Brothers, were the means of bringing to justice Tawell, the murderer, and the *Times* of that date, 1844, observed that 'had it not been for the efficient aid of the electric telegraph, both at the Paddington and Slough Stations, the greatest difficulty, as well as delay, would have been occasioned in the apprehension of the prisoner.' The Henley magneto machine, or 'thunder pump,' has likewise an interest as marking an epoch. The series of coils and needles employed in telegraph apparatus shows the advance made by Holmes in 1848 from the slow pendulous motion of the Cooke and Wheatstone long 5-inch astatic needle combination. Equally instructive is the display of insulators; it must not be forgotten that the early line wires were at times insulated with goose quills.

"Mr. Culley is to be congratulated on the completeness of our Post Office display, and the exhibition of the German Telegraphic Department forms a very complete historical collection of apparatus, from the beginning, to the recently made ingenious contrivances of Messrs. Siemens and Halske, of Berlin. Of the ancient telegraphic apparatus, of which the originals are not sent, such as Gauss and Weber's or Steinteil's apparatus, copies have been forwarded so exactly made that even spots of rust are represented. The automatic Morse recorders and letter-showing telegraphs of Messrs. Siemens deserve most careful study. The automatic Morse cylinder transmitter is comparatively new to this

country, and combines three important elements in its construction: it composes and transmits the messages automatically by means of a single apparatus, the sending of the message being accomplished by the depression of finger-keys corresponding to the letters required, and it possesses great rapidity, transmitting upwards of 90 messages an hour of the ordinary length. The most important forms of magneto current generators for producing the electric light are well represented.

"The original collections of apparatus contain objects which many will be glad to see—the apparatus with which Faraday obtained the magneto-electric spark and his apparatus for magneto-electric induction; also a portion of the battery used by Sir Humphrey Davy in decomposing the alkalies, and much of De la Rive's apparatus used by him both in his researches on passage of the induced current through rarified gases, and first experiments in galvanic gilding.

"Leaving the gallery where are exhibited the electrical and magnetic instruments, we come into that containing the geometrical models and instruments. In this Department is exhibited a collection of ancient mathematical instruments, lent by the Prince of Pless, from his antiquarian museum at Schloss Fürstenstein in Silesia. It is interesting for its completeness as well as for the beauty of workmanship and finish of the instruments, though they date from the beginning of the last century. There are also several beautiful pantographs—instruments, that is, for copying on a reduced or enlarged scale any plane figure—from France and Germany.

"Of the models of figures in space there is a most interesting and extensive collection. Many complicated surfaces are geometrically described by the motion of a right line compelled to move according to some definite law. Surfaces of this kind can evidently be well exhibited to the eye by a series of stretched strings, each of which is made to fulfil the conditions of such a law. A numerous collection of models of this description has been contributed by the South Kensington Museum, for which they were constructed some five years ago by M. Fabre de Lagrange.

"The remaining half of the gallery in which the geometrical models are exhibited is occupied by a remarkable collection of kinematical models from the Royal Gewerbe-Academie of Berlin, and the fact of their being shown here at all is due to the great interest in the Exhibition taken by his Imperial Highness the Crown Prince of Germany. These models, about 300 in number, have been constructed under the direction of Professor Reuleaux, Director of the Academy, and form scarcely a third of the whole series (all, however, that could be spared) used by him in illustrating his lectures on mechanics; they are also mostly described and discussed in his well-known work on 'Theoretische Kinematik.' They are all constructed of metal as they would be in the real machine, all finished to a high degree of accuracy, and work with the utmost ease and smoothness. Every kind of mechanical motion, all the applications of geometry to mechanism, will be here found represented. The whole collection, in its state of completion and in the excellent workmanship of the models, serves to illustrate, by the amount of money and thought which have evidently been spent on it the high perfection to which the Germans have brought instruction in technical science. In the next gallery is another collection of instruments illustrating the laws of Statics and Dynamics, and noteworthy for its historical interest; it contains the apparatus employed

by the celebrated Dutch physicist Gravesande in demonstrating the oscillations of the pendulum, and the parabolic flight of a projectile, and other phenomena of mechanical physics.

"The next section to which we come in this gallery is that of Arithmetic. Necessarily, the appliances for illustrating this branch of science, which can be really called scientific apparatus, are much restricted in number and in character. Of the instruments calculating by machine work the most perfect example will be found in the late Mr. Babbage's calculating machine, or, as he more appropriately called it, difference engine. The machine here shown forms only a part of the original design of Mr. Babbage, but one on this principle was completed by a Swede for the Board of Trade, where it is now used for calculating statistical tables. The Conservatoire des Arts et Métiers at Paris has sent Pascal's calculating machine, bearing date 1642, and the Royal Gewerbe-Academie at Berlin one formerly the property of the celebrated alchemist and charlatan, Hofrath Beyreis. The most notable modern machine of this kind is the tide calculating machine, exhibited by Sir W. Thompson."

The Brussels Humane Exhibition.—The Brussels exhibition of objects relating to public health and safety was opened to the public on June 26th. The ceremony was of a very simple character. At two o'clock the King and Queen of the Belgians arrived at the building, and were presented with an address. To this his Majesty briefly responded, expressing the pleasure he felt in opening the exhibition. He then went through the various sections and inspected their contents.

Let us attempt to form some general idea of the contents of this interesting exhibition. The main entrance leads at once into a hall 763 ft. long, 53 ft. wide. The first quarter of this gallery is taken by the Russian Government. The floor of the gallery is occupied by apparatus used in Russian schools to enforce by unmistakeable experiments the rudimentary laws of health, laws violated in the chimneyless cottages of the Russian peasants as frequently as by natives of countries thought to be more advanced in civilisation. Here are ambulances for the wounded, air-sacks used to raise sunken ships, fog-horns, a sledge boat which runs on ice till the ice breaks and then floats in the water to save life; drawings and models relating to ventilation, to the arrangement of hospitals, extracts of coffee and klukva, designs showing the embankment of rivers, the fixation and planting of shifting sand-hills, &c. In the vast Russian Empire the social reformer is brought face to face with difficulties of which we have no examples in this country. A glimpse of them, and of the kind of efforts now being made to overcome them, is afforded in this exhibition. In addition to their gallery, the Russian Department set up in the grounds a school-house made attractive by wood cut into fantastic shapes, grotesquely representing the crowing cock, which schoolchildren are in all countries taught to reverence as the pattern of early rising. Altogether the Russian section is very original and interesting.

Next to Russia the Belgian collection occupies a considerable space. There is a fine collection of fire-engines, including several steam fire-engines from the workshops of Liège. In the Belgian gallery are fuller models of the works which have reduced the Senne to subjection, the models of the barrage of the Meuse between Namur and the French frontier, &c.

Further on, the German Empire has reared a trophy of flags beneath

which the educational departments of the Cultusministerium of the kingdoms of Prussia and Würtemberg illustrate by plans, desks, and publications their school systems. They give specimens, among other things, of the needlework done in their girls' schools. The Bavarian and Saxon kingdoms are contributors in the same division. The Agricultural Institute of the University of Göttingen sends apparatus, the town of Cologne contributes a model of its new abattoir. Dantsic sends drawings and a plan of its system of canalization. Dusseldorf, Elberfeld, &c., make similar contributions. Among the apparatus destined for the saving of life from fire are numbers of hand engines of fine and light workmanship, and fire escapes like those in use in England, except that they are entirely open, having the ladder, but not the long tube used in our fire-escapes. There are, among other things, drawings showing the process of a manufactory for converting unwholesome meat into manure, Siemens and Helske's electric railway block signals, great numbers of sets of surgical instruments, &c.

At the end of the diagonal gallery a great lighthouse lantern, constructed by Messrs. Chance, for "the Caskets," in the British Channel, shows the commencement of the British collection. A line of railway runs along one side of a narrow corridor, and on this is ranged a magnificent collection of railway waggons, nearly all with the red cross painted upon them to signify that they are for the use of the wounded in war. The most imposing set of objects in the plain white galleries of the Exhibition is the long row of railway carriages marked with the Red Cross of Geneva, in the eastern corridor. They all are sent by the German and Austrian Governments, while the only ambulance waggon sent by the British Government is not a railway carriage at all, but a light cart adapted to conveyance by sea, side by side with which is, however, a collection of field instruments and a complete field hospital, which have excited the admiration of foreigners. Near them is a light and portable fracture-box for field use, sent by Surgeon-Major G. W. M'Nalty, M.D., and a model representing the employment of a simple addition to the American Hodgen's splint for fractured thigh, made by Mr. George Davis, a student at Guy's Hospital, and tried there with success in obviating bed-sores by giving freedom of movement.

No expense has been spared in making the ambulance-waggons sent from Austro-Hungary as complete as possible. They are contributed by the Teutonic Order and the Order of the Knights of Malta, two very wealthy Orders of chivalry, which refuse to admit to their ranks those who cannot show certain quarterings of nobility. Every ambulance-train of the Bohemian Priory of the Knights of Malta consists of 15 waggons. Ten of them are arranged for the conveyance of wounded soldiers, so that 100 men can be carried in the train. Besides these, there is a waggon for the doctors, another for provisions, with safes for ice, wine, &c. Another waggon is the kitchen. The service-waggon carries attendants, with the glass, earthenware and other vessels. The last is the magazine, and contains a library for the use of the patients, extra mattresses, and other bedding. Electric bells give means of communication between each carriage. The carriages are entirely lighted and ventilated from the top, with the object of shutting out the cold draughts of wind, which can scarcely be avoided with side windows. The springs can be adjusted to the number of the patients. The Knights of Malta have ordered ten of these luxurious

trains, which will provide immediate accommodation for 1,000 wounded soldiers. Arrangements have been made with the railway companies to supply, in the event of war, 500 more waggons, which the railway companies themselves undertake to alter by shutting up the side lights, putting the lights overhead, &c., within a fortnight. The railway companies having thus provided the rolling stock, it will be supplied by the Maltese Order with the *personnel* and materials. The Order possess 42 road ambulances for the conveyance of the wounded to the trains or from them. The ambulances are constructed upon the system of Baron Mundey, who is chief physician of the Order.

Holland sends also some ambulances, but this kingdom is chiefly distinguished by a remarkable collection of apparatus for protection against fire, contributed by the city of Amsterdam. A Dutch lifeboat, smaller than the English, but very handsomely and simply built, is shown by the Dutch Humane Society. Its small draught of water (26 centimetres) is specially provided in view of the shoals which endanger the navigation of the Dutch coast. In the same line of corridor space is devoted to Hungary, Italy, and Switzerland. The Venetian collection, with its model of the hospital on Lido, is among the best things in the Italian exhibition. As the sanitary disposal of the mortal remains of the dead is properly part of the business of the Exhibition, the city of Milan sends a model of its appliances for cremation.

A corridor 230 ft. long, and 53 ft. broad, parallel with the English corridor, though shorter, and to the south of it, is occupied by France. In another room are models of the boats which, with a lantern in front, glide silently without the aid of steam, sail, or oar, along the stream which flows through the Parisian sewers and sweep the solid impurities away. In a recess are the appliances which the Paris police find the most useful in restoring life to those who have fallen into the Seine, among them a hollow copper mattress, containing water, which can be rapidly warmed with gas to the heat required. There are maps of the aqueducts which supply Paris, of the course of the Vanne waters, carried over some ravines by arches, drawn across others by syphons, pumped up heights elsewhere, and a model of the great wheel and pumps by which the Marne is raised to the level of the canal of Ourcq at Trilbarnon. The sewage farm of the city at Gennevillers, near Asnières, the hospital in course of construction at Ménilmontant, a pavilion hospital in separate little houses to prevent the spread of puerperal epidemics, are shown by drawings.

Parallel to the diagonal gallery there runs a small corridor devoted to Denmark, Norway, and Sweden, where the Danes show a lifeboat with a double wicker-work frame covered with canvas on each side, the space between the canvas being filled with air, and the boat made thus extremely buoyant. The Swedish collection is very small, but there are important objects shown in it. As lighthouses have become more and more numerous, it has become increasingly difficult for mariners to distinguish among them. Distinction has been sought by coloured lights, revolving lights, &c. These methods do not afford sufficient variety, and Dr. Hopkinson, the Cambridge mathematician, has adopted mechanism for producing flashes of lights in groups, which give abundance of combinations. The lighthouse may thus be made readily distinguishable. Baron Von Otter, a Swede, has founded a promising system upon the principle of this arrangement. He has one light, with blinds which can

shade it. The blinds are opened and shut by mechanism at certain intervals. The long interval represents a line, the short a dot. As soon as dashes and dots can be represented, you have the elements of the Morse alphabet. Combinations of dots and dashes represent all the letters of the alphabet. By means of this alphabet the lighthouse spells its name. A method (the Morse system) which enables telegraph operators to converse at great distances by ear without sight, and is for that reason adopted as an employment for the blind in America, is thus applied to cases where no words at all can be heard. Whether sailors will learn the Morse language readily is the question which suggests itself. The Morse system is also applied by Baron Von Otter to fog signals, whether sirens, whistles, or trumpets.

The Philadelphia Centennial Exhibition.—The Philadelphia Centennial Exhibition was opened by President Grant on May 10, in presence of the Cabinet Ministers, the Judges of the Supreme Court, the members of Congress, the leading naval and military officers, the governors of the States, and a number of distinguished foreign visitors.

Various musical pieces were performed, including a new march, by Wagner, composed expressly for the occasion. President Grant then, in a short speech, declared the Exhibition open to all the world, and proceeded to the Machinery Hall, where he touched the levers of a powerful steam-engine (*see* Frontispiece), which started the entire collection of machinery.

"The buildings of the Exhibition," says a writer in the *Illustrated London News*, "are situated in Fairmount Park, on the banks of the Schuylkill river, above the city of Philadelphia. Every visitor there is favourably impressed with the great skill shown in planning the terminal facilities, which in their convenience far exceed those of any former international exhibition. The grounds are convenient of access to pedestrians, having entrances on the side nearest the city. A large "concourse" at the east end of the main building is devoted to carriages. This adjoins the main highway leading from the city, and has extensive spaces for carriages in waiting. All the horse-car lines, or tramways, as we should call them, lead into another "concourse" on the south side of the main building, and land their passengers at its doors. Passengers arriving by steam railways are landed at two stations—the Pennsylvania Railway station, which is across the street, opposite the square between the main and machinery halls; and the Reading Railway station, at the foot of the hill on the north-east border of the grounds on which the Memorial Hall stands. At the two stations ample facilities are provided for dealing with an enormous passenger-traffic.

"The visitor, arriving by any of these conveyances at the doors of the exhibition, finds on his right hand the great main building, and on his left, three large new hotels—the United States, the Globe, and the Trans-Continental—which have sprung up for the accommodation of guests. In front, on the right hand, are the offices of the Centennial Commission, with the machinery building beyond; on the left hand is the huge passenger station of the Pennsylvania Railroad. He will probably enter the main exhibition building at the east end. Its floor spreads over 400 ft. in width, and 1800 ft. in length. An avenue longitudinally, and another transversely, divide the building into four quarters. These are allotted primarily according to races. Four nations come together at the centre of the building. On the north-west

is Great Britain, the representative of the Anglo-Saxon race; on the south-west, Germany, for the Teuton; on the north-east, France, for the Latin; and on the south-east the United States, as the representative of the 'coming race.' The United States have one-fourth of the building—the south-east quarter, the largest single allotment, and also one third of the north-east quarter. The remainder of the north-east quarter is occupied, one third by France, and the other third by Switzerland, Belgium, Brazil, the Netherlands, and Mexico. Of the north-west quarter, three-fourths are occupied by Great Britain and her colonies, slightly over one half this space being given to the British Islands, and the balance being equally divided between Canada, which takes one half, and India, Australia, and the other colonies, which take the other half. The remainder of the north-west quarter is divided between Norway, Sweden, and Italy. On the south-west quarter the German empire has one fourth; Austria, Hungary, and Russia, another fourth; Spain, Portugal, Turkey, Egypt, Tunis, the Hawaiian Islands, and Denmark, another; and Japan, China, Chili, and Peru, with some smaller states, the last fourth. In the north and east galleries of the main building are placed magnificent organs. A row of large windows over the south centre gallery is set apart for the exhibition of English stained glass, that being the best place possible for such a display. For the carriage and harness articles for exhibition, a separate annexe, nearly 300 ft. square, has been built. Four other annexes, each 140 ft. by 30 ft., are devoted to minerals and metallic articles. The interior decoration of the main building is attractive by its warm and tasteful colouring. The ceiling is a very light blue, the edge just above the cornice having a border of vermilion of a lotus pattern. The beams and rods supporting the ceiling are of buff and lake. The columns supporting the roof are mainly of vermilion, with scroll-work capitals of buff, and the architraves above are also of vermilion, relieved by designs of white and blue, and black and blue. The monogram "C.E.," in black and blue upon a vermilion ground, is placed in each alternate section. The figures "1776" adorn the capital of every third column.

XXVII.—THE BRITISH ASSOCIATION.

PRESIDENT'S ADDRESS.

Delivered by Professor Andrews at Glasgow on the 6th September, 1876.

Six-and-thirty years have passed over since the British Association for the Advancement of Science held its tenth meeting in this ancient city, and twenty-one years have elapsed since it last assembled here. The representatives of two great Scottish families presided on these occasions; and those who had the advantage of hearing the address of the Duke of Argyll in 1855, will recall the gratification they enjoyed while listening to the thoughtful sentiments which reflected a mind of rare cultivation and varied acquirements. On the present occasion I have undertaken, not without anxiety, the duty of filling an office at first accepted by one whom Scotland and the Association would alike have rejoiced to see in this chair, not only as a tribute to his own scientific services, but also as recognising in him the worthy representative of that long line of able men who have upheld the pre-eminent position attained by the Scottish schools of medicine in the middle of the last century, when the mantle of Boerhaave fell upon Monro and Cullen. The task of addressing this Association, always a difficult one, is not rendered easier when the meeting is held in a place which presents the rare combination of being at once an ancient seat of learning and a great centre of modern industry. Time will not permit me to refer to the distinguished men who in early days have left here their mark behind them; and I regret it the more, as there is a growing tendency to exaggerate the value of later discoveries and to underrate the achievements of those who have lived before us. Confining our attention to a period reaching back to little more than a century, it appears that during that time three new sciences arose, at least as far as any science can be said to have a distinct origin, in this city of Glasgow—experimental chemistry, political economy, and mechanical engineering. It is now conceded that Black laid the foundation of modern chemistry; and no one has ever disputed the claims of Adam Smith and of Watt to having not only founded, but largely built up the two great branches of knowledge with which their names will always be inseparably connected. It was here that Dr. Thomas Thomson established the first school of practical chemistry in Great Britain, and that Sir W. Hooker gave to the chair of botany a European celebrity; it was here that Graham discovered the law of gaseous diffusion and the properties of polybasic acids; it was here that Stenhouse and Anderson, Rankine and J. Thomson made some of their finest discoveries; and it was here that Sir William Thomson conducted his physico-mathematical investigations, and invented those exquisite instruments, valuable alike for ocean telegraphy and for scientific use, which are among the finest trophies of recent science. Nor must the names of Tennant, Mackintosh, Neilson, Walter Crum, Young, and Napier be omitted, who, with many others in this place, have made large and valuable additions to practical science.

The safe return of the *Challenger*, after an absence of three years and a half, is a subject of general congratulation. Our knowledge of the varied forms of animal life, and of the remains of animal life, which occur, it is now known, over large tracts of the bed of the ocean, is chiefly derived from the observations made in the *Challenger* and in the previous deep-sea expeditions which were organized by Sir Wyville Thomson and Dr. Carpenter. The physical observations, and especially those on the temperature of the ocean, which were systematically conducted throughout the whole voyage of the *Challenger* have already supplied valuable data for the resolution of the great question of ocean currents. Another expedition, which has more than fulfilled the expectations of the public, is Lieutenant Cameron's remarkable journey across the continent of Africa. It is by such enterprises, happily conceived and ably executed, that we may hope at no distant day to see the Arab slave-dealer replaced by the legitimate trader, and the depressed populations of Africa gradually brought within the pale of civilized life. From the North Polar Expedition no intelligence has been received, nor can we expect for some time to hear whether it has succeeded in the crowning object of Arctic enterprise. In the opinion of many, the results, scientific or other, to be gained by a full survey of the Arctic regions can never be of such value as to justify the risk and cost which must be incurred. But it is not by cold calculations of this kind that great discoveries are made or great enterprises achieved. There is an inward and irrepressible impulse—in individuals called a spirit of adventure, in nations a spirit of enterprise—which impels mankind forward to explore every part of the world we inhabit, however inhospitable or difficult of access; and if the country claiming the foremost place among maritime nations shrink from an undertaking because it is perilous, other countries will not be slow to seize the post of honour. If it be possible for man to reach the poles of the earth, whether north or south, the feat must sooner or later be accomplished; and the country of the successful adventurers will be thereby raised in the scale of nations.

The passage of Venus over the sun's disc is an event which cannot be passed over without notice, although many of the circumstances connected with it have already become historical. It was to observe this rare astronomical phenomenon, on the occasion of its former occurrence in 1769, that Captain Cook's memorable voyage to the Pacific was undertaken, in the course of which he explored the coast of New South Wales, and added that great country to the possessions of the British Crown. As the transit of Venus gives the most exact method of calculating the distance of the earth from the sun, extensive preparations were made on the last occasion for observing it at selected stations—from Siberia, in northern, to Kerguelen's Land, in southern latitudes. The great maritime powers vied with each other to turn the opportunity to the best account; and Lord Lindsay had the spirit to equip, at his own expense, the most complete expedition which left the shores of this country. Some of the most valuable stations in southern latitudes were desert islands, rarely free from mist or tempest, and without harbours or shelter of any kind. The landing of the instruments was in many cases attended with great difficulty, and even personal risk. Photography lent its aid to record automatically the progress of the transit; and M. Janssen contrived a revolving plate, by means of which

from 50 to 60 images of the edge of the sun could be taken at short intervals during the critical periods of the phenomenon. The observations of M. Janssen at Nagasaki, in Japan, were of special interest. Looking through a violet-blue glass he saw Venus, two or three minutes before the transit began, having the appearance of a pale round spot near the edge of the sun. Immediately after contact the segment of the planet's disc, as seen on the face of the sun, formed with what remained of this spot a complete circle. The pale spot when first seen was, in short, a partial eclipse of the solar corona, which was thus proved beyond dispute to be a luminous atmosphere surrounding the sun. Indications were at the same time obtained of the existence of an atmosphere around Venus. The mean distance of the earth from the sun was long supposed to have been fixed within a very small limit of error at about 95,000,000 miles. The accuracy of this number had already been called in question on theoretical grounds by Hansen and Leverrier, when Foucault, in 1862, decided the question by an experiment of extraordinary delicacy. Taking advantage of the revolving mirror, with which Wheatstone had some time before enriched the physical sciences, Foucault succeeded in measuring the absolute velocity of light in space by experiments on a beam of light, reflected backwards and forwards, within a tube little more than 13ft. in length. Combining the result thus obtained with what is called by astronomers the constant of aberration, Foucault calculated the distance of the earth from the sun, and found it to be 1-30th part, or about 3,000,000 miles, less than the commonly received number. This conclusion has lately been confirmed by M. Cornu, from a new determination he has made of the velocity of light, according to the method of Fizeau; and in complete accordance with these results are the investigations of Leverrier, founded on a comparison with theory of the observed motions of the sun and of the planets of Venus and Mars. It remains to be seen whether the recent observations of the transit of Venus, when reduced, will be sufficiently concordant to fix with even greater precision the true distance of the earth from the sun. In this brief reference to one of the finest results of modern science, I have mentioned a great name whose loss England has recently had to deplore, and in connexion with it the name of an illustrious physicist, whose premature death deprived France, a few years ago, of one of her brightest ornaments—Wheatstone and Foucault, ever to be remembered for their marvellous power of eliciting, like Galileo and Newton, from familiar phenomena the highest truths of nature.

The discovery of Huggins, that some of the fixed stars are moving towards and others receding from our system, has been fully confirmed by a careful series of observations lately made by Mr. Christie in the observatory of Greenwich. Mr. Huggins has not been able to discover any indications of a proper motion in the nebulæ; but this may arise from the motion of translation being less than the method would discover. Few achievements in the history of science are more wonderful than the measurement of the proper motions of the fixed stars, from observing the relative position of two delicate lines of light in the field of the telescope. The observation of the American astronomer Young, that bright lines, corresponding to the ordinary lines of Fraunhofer reversed, may be seen in the lower strata of the solar atmosphere for a few moments during a total eclipse, has been confirmed by Mr.

Stone, on the occasion of the total eclipse of the sun which occurred some time ago in South Africa. In the outer corona, or higher regions of the sun's atmosphere, a single green line only was seen, the same which had been already described by Young. I can here refer only in general terms to the observations of Roscoe and Schuster on the absorption-bands of potassium and sodium, and to the investigations of Lockyer on the absorptive powers of metallic and metalloidal vapours at different temperatures. From the vapour of calcium the latter has obtained two wholly distinct spectra, one belonging to a low, and the other to a high temperature. Mr. Lockyer is also engaged on a new and greatly extended map of the solar spectrum. Spectrum analysis has lately led to the discovery of a new metal—gallium—the fifth whose presence has been first indicated by that powerful agent. This discovery is due to M. Lecoq de Boisbaudran, already favourably known by a work on the application of the spectroscope to chemical analysis. Our knowledge of aerolites has of late years been greatly increased, and I cannot occupy a few moments of your time more usefully than by briefly referring to the subject. So recently as 1860 the most remarkable meteoric fall on record, not even excepting that of L'Aigle, occurred near the village of New Concord, in Ohio. On a day when no thunder-clouds were visible, loud sounds were heard resembling claps of thunder, followed by a large fall of meteoric stones, some of which were distinctly seen to strike the earth. One stone, above 50lb. in weight, buried itself to the depth of two feet in the ground, and when dug out was found to be still warm. In 1872 another remarkable meteorite, at first seen as a brilliant star with a luminous train, burst near Orvinio, in Italy, and six fragments of it were afterwards collected. Isolated masses of metallic iron, or rather of an alloy of iron and nickel, similar in composition and properties to the iron usually diffused in meteoric stones, have been found here and there on the surface of the earth, some of large size, as one described by Pallas, which weighed about two-thirds of a ton. Of the meteoric origin of these masses of iron there is little room for doubt, although no record exists of their fall. Sir Edward Sabine, whose life has been devoted with rare fidelity to the pursuit of science, and to whose untiring efforts this association largely owes the position it now occupies, was the pioneer of the new discoveries in meteoric science. Fifty-eight years ago he visited, with Captain Ross, the northern shores of Baffin's Bay, and made the interesting discovery that the knife-blades used by the Esquimaux in the vicinity of the Arctic highlands were formed of meteoric iron. This observation was afterwards fully confirmed; and scattered blocks of meteoric iron have been found from time to time around Baffin's Bay.

But it was not until 1870 that the meteoric treasures of Baffin's Bay were truly discovered. In that year there was found at a part of the shore difficult of approach, even in moderate weather, enormous blocks of meteoric iron, the largest weighing nearly 20 tons, embedded in a ridge of basaltic rock. The interest of this observation is greatly enhanced by the circumstance that these masses of meteoric iron, like the basalt with which they are associated, do not belong to the present geological epoch, but must have fallen long before the actual arrangement of land and sea existed—during, in short, the middle Tertiary, or Miocene period of Lyell. The meteoric origin of these iron masses from Ovifak has been called in ques-

tion by Lawrence Smith; and it is no doubt possible that they may have been raised by upheaval from the interior of the earth. I have, indeed, myself shown by a magneto-chemical process that metallic iron, in particles so fine that they have never yet been actually seen, is everywhere diffused through the Miocene basalt of Slieve Mish, in Antrim, and may likewise be discovered by careful search in almost all igneous, and in many metamorphic rocks. These observations have since been verified by Reuss in the case of the Bohemian basalts, But, as regards the native iron of Ovifak, the weight of evidence appears to be in favour of the conclusion at which M. Daubrée, after a careful discussion of the subject, has arrived —that it is really of meteoric origin. This Ovifak iron is also remarkable from containing a considerable amount of carbon, partly combined with the iron, partly diffused through the metallic mass in a form resembling coke. In connection with this subject I must refer to the able and exhaustive memoirs of Maskelyne on the Busti and other aerolites, to the discovery of vanadium by R. Apjohn in the meteoric iron, to the interesting observations of Sorby, and to the researches of Daubrée, Wohler, Lawrence Smith, Tschermak, and others.

The important services which the Kew Observatory has rendered to meteorology and to solar physics have been fully recognized; and Mr. Gassiot has had the gratification of witnessing the final success of his long and noble efforts to place this observatory upon a permanent footing. A physical observatory for somewhat similar objects, but on a larger scale, is in course of erection, under the guidance of M. Janssen, at Fontenay, in France, and others are springing up or already exist in Germany and Italy. It is earnestly to be hoped that this country will not lag behind in providing physical observatories on a scale worthy of the nation and commensurate with the importance of the object. On this question I cannot do better than refer to the high authority of Dr. Balfour Stewart, and to the views he expressed in his able address last year to the Physical Section. Weather telegraphy, or the reporting by telegraph the state of the weather at selected stations to a central office, so that notice of the probable approach of storms may be given to the seaports, has become in this country an organized system; and, considering the little progress meteorology has made as a science, the results may be considered to be, on the whole, satisfactory. Of the warnings issued of late years, four out of five were justified by the occurrence of gales or strong winds. Few storms occurred for which no warnings had been given, but, unfortunately, among these were some of the heaviest gales of the period. The stations from which daily reports are sent to the Meteorological Office in London embrace the whole coast of Western Europe, including the Shetland Isles. It appears that atmospheric disturbances seldom cross the Atlantic without being greatly altered in character, and that the origin of most of our storms lies eastward of the longitude of Newfoundland. As regards the velocity of the wind, the cup-anemometer of Dr. Robinson has fully realized the expectations of its discoverer; and the venerable astronomer of Armagh has been engaged during the past summer, with all the ardour of youth, in a course of laborious experiments to determine the constants of his instrument. From seven year's observations at the observatory of Armagh, he has found that the mean velocity of wind is greatest in the S.S.W., octant and least in the opposite one,

and that the amount of wind attains a *maximum* in January, after which it steadily decreases, with one slight exception, till July, augmenting again till the end of the year.

Passing to the subject of electricity, it is with pleasure that I have to announce the failure of a recent attempt to deprive Oerstedt of his great discovery. It is gratifying thus to find high reputations vindicated, and names which all men love to honour transmitted with undiminished lustre to posterity. To Franklin, Volta, Coulomb, Oerstedt, Ampere, Faraday, Seebeck, and Ohm are due the fundamental discoveries of modern electricity—a science whose applications in Davy's hands led to grander results than alchymist ever dreamt of, and in the hands of others (among whom Wheatstone, Morse, and Thomson occupy the foremost place) to the marvels of the electric telegraph. When we proceed from the actual phenomena of electricity to the molecular conditions upon which those phenomena depend, we are confronted with questions as recondite as any with which the physicist has had to deal, but towards the solution of which the researches of Faraday have contributed the most precious materials. The theory of electrical and magnetic action occupied formerly the powerful minds of Poisson, Green, and Gauss; and among the living it will surely not be invidious to cite the names of Weber, Helmholtz, Thomson and Clerk Maxwell. The work of the latter on electricity is an original essay worthy in every way of the great reputation and of the clear and far-seeing intellect of its author. Among recent investigations I must refer to Professor Tait's discovery of consecutive neutral points in certain thermo-electric junctions, for which he was lately awarded the Keith prize. This discovery has been the result of an elaborate investigation of the properties of thermo-electric currents, and is especially interesting in reference to the theory of dynamical electricity. Nor can I omit to mention the very interesting and original experiments of Dr. Kerr on the dielectric state, from which it appears that when electricity of high tension is passed through dielectrics, a change of molecular arrangement occurs, slowly in the case of solids, quickly in the case of liquids, and that the lines of electric force are in some cases lines of compression in other cases lines of extension. Of the many discoveries in physical science due to Sir William Grove, the earliest and not the least important is the battery which bears his name, and is to this day the most powerful of all voltaic arrangements; but with a Grove's battery of 50 or even 100 cells in vigorous action, the spark will not pass through an appreciable distance of cold air. By using a very large number of cells, carefully insulated and charged with water, Mr. Gassiot succeeded in obtaining a short spark through air; and lately De La Rue and Müller have constructed a large chloride of silver battery giving freely sparks through cold air, which, when a column of pure water is interposed in the circuit, accurately resemble those of the common electrical machine. The length of the spark increasing nearly as the square of the number of cells, it has been calculated that with 100,000 elements of this battery the discharge should take place through a distance of no less than 8 ft. in air.

In the solar beam we have an agent of surpassing power, the investigation of whose properties by Newton forms an epoch in the history of experimental science scarcely less important than the discovery of the law of gravitation in the history of physical astronomy. Three actions characterize the solar beam, or, indeed, more or less that

of any luminous body—the heating, the physiological, and the chemical. In the ordinary solar beam we can modify the relative amount of these actions by passing it through different media, and we can thus have luminous rays with little heating or little chemical action. In the case of the moons rays it required the highest skill on the part of Lord Rosse, even with all the resources of the observatory of Parsonstown, to investigate their heating properties, and to show that the surface of our satellite facing the earth passes during every lunation through a greater range of temperature than the difference between the freezing and the boiling point of water. But if, instead of taking an ordinary ray of light, we analyze it as Newton did by the prism and isolate a very fine line of the spectrum (theoretically a line of infinite tenuity)—that is to say, if we take a ray of definite refrangibility, it will be found impossible by screens or otherwise to alter its properties. It was his clear perception of the truth of this principle that led Stokes to his great discovery of the cause of epipolic dispersion in which he showed that many bodies had the power of absorbing dark rays of high refrangibility and of emitting them as luminous rays of lower refrangibility—of absorbing, in short, darkness and emitting it as light. It is not indeed an easy matter in all cases to say whether a given effect is due to the action of heat or light; and the question which of these forces is the efficient agent in causing the motion of the tiny discs in Crooke's radiometer has given rise to a good deal of discussion. The answer to this question involves the same principles as those by which the image traced on the daguerreosype plate, or the decomposition of carbonic acid by the leaves of plants, it referred to the action of light and not of heat; and, applying these principles to the experiments made with the radiometer, the weight of evidence appears to be in favour of the view that the repulsion of the blackened surfaces of the discs is due to a thermal reaction occurring in a highly rarified medium. I have myself had the pleasure of witnessing many of Mr. Crooke's experiments, and I cannot sufficiently express my admiration of the care and skill with which he has pursued this investigation. The remarkable repulsions he has observed in the most perfect *vacua* hitherto attained are interesting, not only as having led to the construction of a beautiful instrument, but as being likely, when the subject is fully investigated, to give valuable *data* for the theory of molecular actions. A singular property of light, discovered a short time ago by Mr. Willoughby Smith, is its power of diminishing the electrical resistance of the element selenium. This property has been ascertained to belong chiefly to the luminous rays on the red side of the spectrum, being nearly absent in the violet or more refrangible rays and also in heat-rays of low refrangibility. The recent experiments of Professor W. G. Adams have fully established the accuracy of the remarkable observation, first made by Lord Rosse, that the action appeared to vary inversely as the simple distance of the illuminating source.

Switzerland sent, some years ago, as its representative to this country, the celebrated De La Rive, whose scientific life formed lately the subject of an eloquent *éloge* from the pen of M. Dumas. On this occasion we have to welcome, in General Menabrea, a distinguished representative both of the Kingdom of Italy and of Italian science. His great work on the determination of the pressures and tensions in an elastic system is of too abstruse a character to be discussed in this ad-

dress; but the principle it contains may be briefly stated in the following words:—"When any elastic system places itself in equilibrium under the action of external forces, the work developed by the internal forces is a *minimum.*" General Menabrea has, however, other and special claims upon us here, as the friend to whom Babbage intrusted the task of making known to the world the principles of his analytical machine—a gigantic conception, the effort to realize which it is known was one of the chief objects of Babbage's later life. The latest development of this conception is to be found in the mechanical integrator of Professor J. Thomson, in which motion is transmitted, according to a new kinematic principle, from a disc or cone to a cylinder through the intervention of a loose ball, and in Sir W. Thomson's machine for the mechanical integration of differential equations of the second order. In the exquisite tidal machine of the latter we have an instrument by means of which the height of the tide at a given port can be accurately predicted for all times of the day and night. The attraction-meter of Siemens is an instrument of great delicacy for measuring horizontal attractions, which it is proposed to use for recording the attractive influences of the sun and moon, upon which the tides depend. The bathometer of the same able physicist is another remarkable instrument, in which the constant force of a spring is opposed to the variable pressure of a column of mercury. By an easy observation of the bathometer on shipboard, the depth of the sea may be approximately ascertained without the use of a sounding-line.

The Loan Exhibition of Apparatus at Kensington has been a complete success, and cannot fail to be useful, both in extending a knowledge of scientific subjects and in promoting scientific research throughout the country. Unique in character, but most interesting and instructive, this Exhibition will, it is to be hoped, be the precursor of a permanent museum of scientific objects, which, like the present exhibition, shall be a record of old, as well as a representation of new, inventions.

It is often difficult to draw a distinct line of separation between the physical and chemical sciences, and it is perhaps doubtful whether the division is not really an artificial one. The chemist cannot, indeed, make any large advance without having to deal with physical principles; and it is to Boyle, Dalton, Gay-Lussac, and Graham that we owe the discovery of the mechanical laws which govern the properties of gases and vapours. Some of these laws have of late been made the subject of searching inquiry, which has fully confirmed their accuracy, when the body under examination approaches to what has not inaptly been designated the ideal gaseous state. But when gases are examined under varied conditions of pressure and temperature, it is found that these laws are only particular cases of more general laws, and that the laws of the gaseous state, as it exists in nature, although they may be enunciated in a precise and definite form, are very different from the simple expressions which apply to the ideal condition. The new laws become in their turn inapplicable when from the gaseous state proper we pass to those intermediate conditions which, it has been shown, link with unbroken continuity the gaseous and liquid states. As we approach the liquid state, or even when we reach it, the problem becomes more complicated; but its solution even in these cases will, it may confidently be expected, yield to the powerful means of investigation we now possess. Among

the more important researches made of late in physical chemistry, I may mention those of F. Weber on the specific heat of carbon and the allied elements, of Berthelot on thermo-chemistry, of Bunsen on spectrum analysis, of Wüllner on the band and line spectra of the gases, and of Guthrie on the cryohydrates. Cosmical chemistry is a science of yesterday, and yet it already abounds in facts of the highest interest. Hydrogen, which, if the absolute zero of the physicist does not bar the way, we may hope yet to see in the metallic form, appears to be everywhere present in the universe. It exists in enormous quantity in the solar atmosphere, and it has been discovered in the atmospheres of the fixed stars. It is present, and is the only known element of whose presence we are certain, in those vast sheets of ignited gas of which the nebulæ proper are composed. Nitrogen is also widely diffused among the stellar bodies, and carbon has been discovered in more than one of the comets. On the other hand, a prominent line in the spectrum of the Aurora Borealis has not been identified with that of any known element; and the question may be asked, Does a new element, in a highly rarefied state, exist in the upper regions of our atmosphere? or are we with Angström to attribute this line to a fluorescent or phosphorescent light produced by the electrical discharge to which the aurora is due? This question awaits further observations before it can be definitely settled, as does also that of the source of the remarkable green line which is everywhere conspicuous in the solar corona. I must here pause for a moment to pay a passing tribute to the memory of Angström, whose great work on the solar spectrum will always remain as one of the finest monuments of the science of our period. The influence, indeed, which the labours of Angström and of Kirchoff have exerted on the most interesting portion of later physics can scarcely be exaggerated; and it may be truly said that there are few men whose loss will be longer felt or more deeply deplored than that of the illustrious astronomer of Upsala. I cannot pursue this subject further, nor refer to the other terrestial elements which are present in the solar and stellar atmospheres. Among the many elements that make up the ordinary areolite, not one has been discovered which does not occur upon this earth. On the whole, we arrive at the grand conclusion that this mighty universe is chiefly built up of the same materials as the globe we inhabit.

In the application of science to the useful purposes of life, chemistry and mechanics have run an honourable race. It was in the valley of the Clyde that the chief industry of this country received, within the memory of many here present, an extraordinary impulse from the application by Neilson of the hot blast to the smelting of iron. The Bessemer steel process and the regenerative furnace of Siemens are later applications of high scientific principles to the same industry. But there is ample work yet to be done. The fuel consumed in the manufacture of iron, as, indeed, in every furnace where coal is used, is greatly in excess of what theory indicates; and the clouds of smoke which darken the atmosphere of our manufacturing towns, and even of whole districts of country, are a clear indication of the waste, but only of a small portion of the waste, arising from imperfect combustion. The depressing effect of this atmosphere upon the working population can scarcely be overrated. Their pale, I had almost said etiolated, faces are a sure indication of the absence of the vivifying influence of the solar rays, so essential to the

maintenance of vigorous health. The chemist can furnish a simple test of this state of the atmosphere in the absence of ozone, the active form of oxygen, from the air of our large towns. At some future day the efforts of science to isolate, by a cheap and available process, the oxygen of the air for industrial purposes may be rewarded with success. The effect of such a discovery would be to reduce the consumption of fuel to a fractional part of its present amount; and, although the carbonic acid would remain, the smoke and carbonic oxide would disappear. But an abundant supply of pure oxygen is not now within our reach; and, in the meantime, may I venture to suggest that in many localities the waste products of the furnace might be carried off to a distance from the busy human hive by a few horizontal flues of large dimensions, terminating in lofty chimneys on a hillside or distant plain? A system of this kind has long been employed at the mercurial mines of Idria, and in other smelting works where noxious vapours are disengaged. With a little care in the arrangements, the smoke would be wholly deposited, as flue-dust or soot, in the horizontal galleries, and would be available for the use of the agriculturist. The future historian of organic chemistry will have to record a succession of beneficent triumphs, in which the efforts of science have led to results of the highest value to the well-being of man. The discovery of quinine has probably saved more human life, with the exception of that of vaccination, than any discovery of any age; and he who succeeds in devising an artificial method of preparing it will be truly a benefactor of the race. Not the least valuable, as it has been one of the most successful, of the works of our Government in India, has been the planting of the cinchona-tree on the slopes of the Himalaya. As artificial methods are discovered, one by one, of preparing the proximate principles of the useful dyes, a temporary derangement of industry occurs, but in the end the waste materials of our manufactures set free large portions of the soil for the production of human food. The ravages of insects have ever been the terror of the agriculturist, and the injury they inflict is often incalculable. An enemy of this class, carried over from America, threatened lately with ruin some of the finest vine districts in the South of France. The occasion has called forth a chemist of high renown, and in a classical memoir, recently published, M. Dumas appears to have resolved the difficult problem. His method, although immediately applied to the *phylloxera* of the vine, is a general one, and will no doubt be found serviceable in other cases. In the apterous state the *phylloxera* attacks the roots of the plant, and the most efficacious method hitherto known of destroying it has been to inundate the vineyard. After a long and patient investigation, M. Dumas has discovered that the sulphocarbonate of potassium, in dilute solution, fulfils every condition required from an insecticide, destroying the insect without injuring the plant. The process requires time and patience, but the trials in the vineyard have fully confirmed the experiments of the laboratory.

The application of artificial cold to practical purposes is rapidly extending; and, with the improvement of the ice-machine, the influence of this agent upon our supply of animal food from distant countries will undoubtedly be immense. The ice-machine is already employed in paraffin works and in large breweries; and the curing or salting of meat is now largely conducted in vast chambers, maintained throughout the summer at a constant tem-

perature by a thick covering of ice.

I have now completed this brief review, rendered difficult by the abundance, not by the lack, of materials. Even confining our attention to the few branches of science upon which I have ventured to touch, and omitting altogether the whole range of pure chemistry, it is with regret that I find myself constrained to make only a simple reference to the important work of Cayley on the Mathematical Theory of Isomers, and to elaborate memoirs which have recently appeared in Germany on the reflection of heat and light rays, and on the specific heat and conducting power of gases for heat, by Knoblauch, E. Wiedemann, Winkelmann, and Buff.

The decline of science in England formed the theme, 50 years ago, of an elaborate essay by Babbage; but the brilliant discoveries of Faraday soon after wiped off the reproach. I will not venture to say that the alarm which has lately arisen, here and elsewhere, on the same subject, will prove to be equally groundless. The duration of every great outburst of human activity, whether in art, in literature, or in science, has always been short, and experimental science has made gigantic advances during the last three centuries. The evidence of any great failure is not, however, very manifest, at least in the physical sciences. The journal of Poggendorff, which has long been a faithful record of the progress of physical research throughout the world, shows no signs of flagging; and the *Jubelband* by which Germany celebrated the 50th year of Poggendorff's invaluable services was at the same time an ovation to a scientific veteran, who has, perhaps, done more than any man living to encourage the highest forms of research, and a proof that in Northern Europe the physical sciences continue to be ably and actively cultivated. If in chemistry the case is somewhat weaker, the explanation, at least in this country, is chiefly to be found in the demand on the part of the public for professional aid from many of our ablest chemists. But, whatever view be taken of the actual condition of scientific research, there can be no doubt that it is both the duty and the interest of the country to encourage a pursuit so ennobling in itself and fraught with such important consequences to the well-being of the community. Nor is there any question in which this association, whose special aim is the advancement of science, can take a deeper interest. The public mind has also been awakened to its importance, and is prepared to aid in carrying out any proposal which offers a reasonable prospect of advantage. In its recent phase the question of scientific research has been mixed up with contemplated changes in the great Universities of England and particularly in the University of Oxford. The national interests involved on all sides are immense, and a false step once taken may be irretrievable. It is with diffidence that I now refer to the subject, even after having given to it the most anxious and careful consideration. As regards the higher mathematics, their cultivation has hitherto been chiefly confined to the Universities of Cambridge and Dublin, and two great mathematical schools will probably be sufficient for the kingdom. The case of the physical and natural sciences is different, and they ought to be cultivated in the largest and widest sense at every complete University. Nor, in applying this remark to the English Universities, must we forget that if Cambridge was the *Alma Mater* of Newton and Cavendish, Oxford gave birth to the Royal Society. The ancient renown

of Oxford will surely not suffer, while her material position cannot fail to be strengthened, by the expansion of scientific studies and the encouragement of scientific research within her walls. Nor ought such a proposal to be regarded as in any way hostile to the literary studies, and especially to the ancient classical studies, which have always been so carefully cherished at Oxford. If, indeed, there were any such risk, few would hesitate to exclaim, "Let science shift elsewhere for herself, and let literature and philosophy find shelter in Oxford." But there is no ground for any such anxiety. Literature and science, philosophy and art, when properly cultivated, far from opposing, will mutually aid one another. There will be ample room for all, and, by judicious arrangements, all may receive the attention they deserve. A University, or *Studium Generale*, ought to embrace in its arrangements the whole circle of studies which involve the material interests of society, as well as those which cultivate intellectual refinement. The industries of the country should look to the Universities for the development of the principles of applied as well as of abstract science; and in this respect no institutions have ever had so grand a possession within easy reach as have the Universities of England at this conjuncture, if only they have the courage to seize it. With their historic reputation, their collegiate endowments, their commanding influences, Oxford and Cambridge should continue to be all that they now are; but they should, moreover, attract to their lecture-halls and working cabinets students in large numbers preparing for the higher industrial pursuits of the country. The great physical laboratory in Cambridge, founded and equipped by the noble representative of the House of Cavendish, has in this respect a peculiar significance, and is an important step in the direction I have indicated. But a small number only of those for whom this temple of science is designed are now to be found in Cambridge. It remains for the University to perform its part, and to widen its portals so that the nation at large may reap the advantage of this well-timed foundation. If the Universities, in accordance with the spirit of their statutes, or at least of ancient usage, would demand from the candidates for some of the higher degrees proof of original powers of investigation, they would give an important stimulus to the cultivation of science. The example of many Continental Universities, and among others of the venerable University of Leyden, may here be mentioned. Two proof essays recently written for the degree of Doctor of Science of Leyden, one by Van der Waals, the other by Lorenz, are works of unusual merit; and another pupil of Professor Rijke is now engaged in an elaborate experimental research as a qualification for the same degree.

The endowment of a body of scientific men devoted exclusively to original research, without the duty of teaching or other occupation, has of late been strongly advocated in this country; and M. Fremy has given the weight of his high authority to a somewhat similar proposal for the encouragement of research in France. I will not attempt to discuss the subject as a national question, the more so as, after having given the proposal the most careful consideration in my power, and turned it round on every side, I have failed to discover how it could be worked so as to secure the end in view. But, whatever may be said in favour of the endowment of pure research as a national question, the Universities ought surely never to be asked to give their aid to a measure which would separate the higher

intellects of the country from the flower of its youth. It is only through the influence of original minds that any great or enduring impression can be produced on the hopeful student. Without original power, and the habit of exercising it, you may have an able instructor, but you cannot have a great teacher. No man can be expected to train others in habits of observation and thought he has never acquired himself. In every age of the world the great schools of learning have, as in Athens of old, gathered around great and original minds, and never more conspicuously than in the modern schools of chemistry, which reflected the genius of Liebig, Wöhler, Bunsen, and Hofmann. These schools have been nurseries of original research as well as models of scientific teaching; and students attracted to them from all countries became enthusiastically devoted to science, while they learned its methods from example even more than from precept. Will any one have the courage to assert that organic chemistry, with its many applications to the uses of mankind, would have made in a few short years the marvellous strides it has done, if Science, now as in mediæval times, had pursued her work in strict seclusion,

> "Semota ab nostris rebus, seiunctaque longe,
> "Ipsa suis pollens, opibus, nil indiga nostri?"

But, while the Universities ought not to apply their resources in support of a measure which would render their teaching ineffective, and would at the same time dry up the springs of intellectual growth, they ought to admit freely to University positions men of high repute from other Universities, and even without academic qualifications. An honorary degree does not necessarily imply a University education; but, if it have any meaning at all, it implies that he who has obtained it is at least on a level with the ordinary graduate, and should be eligible to University positions of the highest trust. Not less important would it be for the encouragement of learning throughout the country that the English Universities, remembering that they were founded for the same objects, and derive their authority from a common source, should be prepared to recognize the ancient Universities of Scotland as freely as they have always recognized the Elizabethan University of Dublin. Such a measure would invigorate the whole University system of the country more than any other I can think of. . . . If this union were established among the old Universities, and if at the same time a new University (as I myself ten years age earnestly proposed) were founded on sound principles amid the great populations of Lancashire and Yorkshire, the University system of the country would gradually receive a large and useful extension, and, without losing any of its present valuable characteristics, would become more intimately related than hitherto with those great industries upon which mainly depend the strength and wealth of the nation.

It may perhaps appear to many a paradoxical assertion to maintain that the industries of the country should look to the calm and serene regions of Oxford and Cambridge for help in the troublous times of which we have now a sharp and severe note of warning. But I have not spoken on light grounds, nor without due consideration. If Great Britain is to retain the commanding position she has so long occupied in skilled manufacture, the easy ways which (owing partly to the high qualities of her people, partly to the advantages of her insular position and mineral wealth) have sufficed for the past will not be found to

suffice for the future. The highest training which can be brought to bear on practical science will be imperatively required; and it will be a fatal policy if that training is to be sought for in foreign lands, because it cannot be obtained at home. The country which depends unduly on the stranger for the education of its skilled men, or neglects in its highest places this primary duty, may expect to find the demand for such skill gradually pass away, and along with it the industry for which it was wanted. I do not claim for scientific education more than it will accomplish, nor can it ever replace the after-training of the workshop or factory. Rare and powerful minds have, it is true, often been independent of it; but high education always gives an enormous advantage to the country where it prevails. Let no one suppose I am now referring to elementary instruction, and much less to the active work which is going on everywhere around us, in preparing for examinations of all kinds. These things are all very useful in their way; but it is not by them alone that the practical arts are to be sustained in the country. It is by education in its highest sense, based on a broad scientific foundation, and leading to the application of science to practical purposes—in itself one of the noblest pursuits of the human mind—that this result is to be reached. That education of this kind can be most effectively given in a University, or in an institution like the Polytechnic School of Zurich, which differs from the scientific side of a University only in name, and to a large extent supplements the teaching of an actual University, I am firmly convinced; and for this reason, among others, I have always deemed the establishment in this country of Examining Boards with the power of granting degrees, but with none of the higher and more important functions of a University, to have been a measure of questionable utility. It is to Oxford and Cambridge, widely extended as they can readily be, that the country should chiefly look for the development of practical science; they have abundant resources for the task; and if they wish to secure and strengthen their lofty position, they can do it in no way so effectually as by showing that in a green old age they preserve the vigour and elasticity of youth.

If any are disposed to think that I have been carrying this meeting into dreamland, let them pause and listen to the results of similar efforts to those I have been advocating, undertaken by a neighbouring country when on the verge of ruin, and steadily pursued by the same country in the climax of its prosperity. "The University of Berlin," to use the words of Hofmann, "like her sister of Bonn, is a creation of our century. It was founded in the year 1810, at a period when the pressure of foreign domination weighed almost insupportably on Prussia; and it will ever remain significant of the direction of the German mind that the great men of that time should have hoped to develop, by high intellectual training, the forces necessary for the regeneration of their country." It is not for me, especially in this place, to dwell upon the great strides which Northern Germany has made of late years in some of the largest branches of industry, and particularly in those which give a free scope for the application of scientific skill. "Let us not suppose," says M. Wurtz in his recent report on the Artificial Dyes, "that the distance is so great between theory and its industrial applications. This report would have been written in vain if it had not brought clearly into view the immense influence of pure science upon the

progress of industry. If, unfortunately, the sacred flame of science should burn dimly or be extinguished, the practical arts would soon fall into rapid decay. The outlay which is incurred by any country for the promotion of science and of high instruction will yield a certain return; and Germany has not had long to wait for the ingathering of the fruits of her far-sighted policy. Thirty or forty years ago, industry could scarcely be said to exist there; it is now widely spread and successful." As an illustration of the truth of these remarks, I may refer to the newest of European industries, but one which in a short space of time has attained considerable magnitude. It appears (and I make the statement on the authority of M. Wurtz) that the artificial dyes produced last year in Germany exceeded in value those of all the rest of Europe, including England and France. Yet Germany has no special advantage for this manufacture, except the training of her practical chemists.

We are not, it is true, to attach undue importance to a single case; but the rapid growth of other and larger industries points in the same direction, and will, I trust, secure some consideration for the suggestions I have ventured to make.

Whatever be the result of our efforts to advance science and industry, it requires no gift of prophecy to declare that the boundless resources which the supreme Author and Upholder of the Universe has provided for the use of man will, as time rolls on, be more and more fully applied to the improvement of the physical and, through the improvement of the physical, to the elevation of the moral condition of the human family. Unless, however, the history of the future of our race be wholly at variance with the history of the past, the progress of mankind will be marked by alternate periods of activity and repose; nor will it be the work of any one nation or of any one race. To the erection of the edifice of civilised life, as it now exists, all the higher races of the world have contributed; and, if the balance were accurately struck, the claims of Asia for her portion of the work would be immense, and those of Northern Africa not insignificant. Steam power has of late years produced greater changes than probably ever occurred before in so short a time. But the resources of nature are not confined to steam, nor to the combustion of coal. The steady water-wheel and the rapid turbine are more perfect machines than the stationary steam-engine; and glacier-fed rivers with natural reservoirs, if fully turned to account, would supply an unlimited and nearly constant source of power depending solely for its continuance upon solar heat. But no immediate dislocation of industry is to be feared, although the turbine is already at work on the Rhine and the Rhone. In the struggle to maintain their high position in science and its applications, the countrymen of Newton and Watt will have no ground for alarm so long as they hold fast to their old traditions, and remember that the greatest nations have fallen when they relaxed in those habits of intelligent and steady industry upon which all permanent success depends.

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